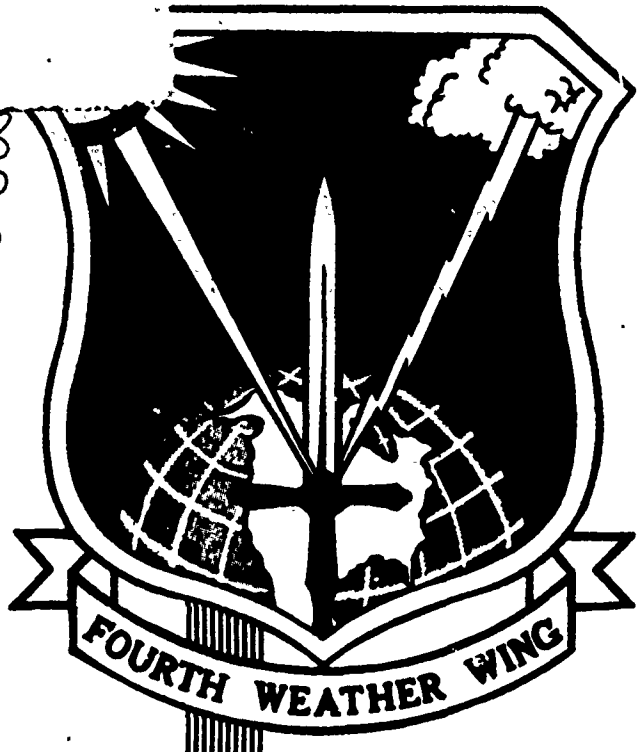

Technical Paper 70-1

THE VALUE OF STATIC AND TREND PERSISTENCE IN THE ONE-HOUR PREDICTION OF CEILING AND VISIBILITY

THE VALUE OF STATIC AND TREND PERSISTENCE IN THE ONE-HOUR PREDICTION OF CEILING AND VISIBILITY

by

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February 1970

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PREFACE

One of the most popular forecasting tools employed in the preparation of one-hour ceiling and visibility forecasts is "persistence forecasting." The popularity of this tool stems from the fact that it is a purely mechanical method, and requires a minimum amount of meteorological skill and time in its application. Impetus for employing this tool is frequently supplied by results from various verification studies where general conclusions are made that the highest verification scores are always obtained with persistence forecasts. Usually, these conclusions refer only to the overall percent correct scores for all ceilings (or visibilities) combined, which are indeed high due to the inclusion of the large number of cases with high ceilings and visibilities which are very persistent. Few verification studies contain a comprehensive evaluation of persistence forecasts for a complete spectrum of initial ceiling and visibility conditions, and those that do are limited to only a few years data. In addition, difficulties in the interpretation of results from verification studies are created due to the vague definition of the term "persistence forecast." The term actually has different meanings to different meteorologists.

It is felt therefore that a need exists for clarifying the term "persistence forecast" and for a comprehensive quantitative evaluation utilizing a large sample of data over a wide spectrum of initial ceiling and visibility conditions. The purpose of this paper is to contribute to this need.

In addition to the authors, others involved in conducting this study included Capt A. Cotton who prepared the original computer program, and MSgt R. Helms and SSgt V. Medina who performed many of the machine printout analyses. The helpful suggestions provided by members of the 4th Weather Wing Aerospace Sciences Division are also gratefully acknowledged. The authors are also grateful to Mrs. M. Jasmund for the editorial preparation of this paper.

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SECTION I - INTRODUCTION AND DEFINITION OF TERMS

For many years, much attention has been directed toward developing uses of persistence in applied meteorology. In general, these efforts can be classified into two groups. In one, attention has been directed toward uses of persistence as a forecast evaluation tool, and in the second, toward uses of persistence as a forecasting aid. As an evaluation tool, "persistence forecasts" are frequently used as a standard of comparison in evaluating newly developed forecast methods or in measuring the skill of forecasters. In this application, the persistence forecast is considered as a professionally unskilled forecast which should be surpassed if any degree of skill is claimed. Most of the published literature dealing with forecast evaluation studies include a discussion on the comparison of a particular technique against persistence. Some comprehensive evaluation studies of this type include those conducted by Travelers Research Center [1] and others [2] , [3] . Illustrations of the use of persistence forecasts as a yardstick in measuring forecaster skill are studies such as [4] , and the Air Weather Service Product Evaluation Program [5] . As a forecasting tool, persistence is often incorporated into objective forecast studies as one of the predictors as described in [6] . In recent years the most popular application of persistence as a forecast aid has been through "persistence probability" tables [7] , onset-duration tables [8] , and other statistical tables derived from climatological data. These aids are designed to encourage the most intelligent and effective utilization of persistence in the daily forecast routine.

Although a variety of literature is available on uses of persistence it should be noted that the term "persistence forecast" apparently has different meanings to different meteorologists. The basic definition [9] of this term is "...a forecast that the future weather condition will be the same as the present condition." Although this definition appears simple, it is surprising to note the many different ways in which it is applied and the different interpretations made from conclusions in published studies, particularly those dealing with ceiling and visibility. Some of the confusion stems from different choices of the "initial weather condition." Some use individual ceiling and visibility values; some use individual ceiling and visibility categories; and others use combined ceiling/visibility categories. Additional confusion is introduced by some forecasters who apply the term "persistence forecast" to the continuation (or persistence) of an established trend in ceiling and visibility values (or categories). The term "persistence" is indeed an equivocal term.

In order to simplify further discussion in this paper, certain definitions will be introduced periodically. At this point, it would be well to introduce the term, STATIC PERSISTENCE, which is

defined as the repetition of an initial value (or category) for a given forecast period, regardless of any previous trends. In this paper, the forecast period is one hour. TREND PERSISTENCE is defined as the continuation of an established trend in values (or categories) as determined from the initial condition and previously recorded observations.

1. Static Persistence of Ceiling and Visibility Values vs Categories. To some meteorologists, the term "persistence forecast" means simply a "no change" forecast of the initial ceiling or visibility category to which the initial value was arbitrarily assigned. For example, consider a particular ceiling category which is defined as includes ceilings between 500-900 feet. Suppose the initial ceiling value is 500 feet hour forecast calls for a 900-foot ceiling. This is a static persistence forecast of the ceiling category, but is certainly not a static persistence forecast of the ceiling value. There is a distinction, therefore, between category-persistence and value-persistence. Studies which deal with category-persistence will naturally yield higher verification scores than those dealing with value-persistence and therefore, tend to overestimate the value of persistence. This tendency is further amplified by defining broader categories and using combined ceiling/visibility categories. Quite often, the reader is not aware of these differences in definitions by different investigators and may blindly accept certain conclusions without any qualification. To illustrate a few of these differences:

a. Travelers Research Center [1] used persistence forecasts in categorical form using five ceiling categories and five visibility categories. Some of the ceiling categories were rather broad (e.g., Category 4: $\geq$ 1000 feet but $<$ 3000 feet and Category 5 included the extremely broad category of all ceilings $\geq$ 3000 feet).

b. Melpar Inc. [2] also shred out their data separately by ceiling and visibility, but instead of fixed categories, used variable tolerance limits to define persistence forecasts. For a given initial ceiling value, the ceiling was said to "persist" if the ceiling remained within certain limits (e.g., for initial ceiling values $>$ 1000 feet but $\leq$ 2000 feet, the ceiling was said to persist if it remained within $\pm$300 feet of the initial value; however, for initial ceiling values $>$500 feet but $\leq$ 1000 feet, a ceiling persisted if it remained within $\pm$200 feet of the initial value).

c. In [4] and [5], the ceiling and visibility data are lumped together into combined ceiling/visibility categories. In the AWS Product Evaluation Program [5], the initial ceiling and visibility values are grouped into five initial ceiling and/or visibility categories (e.g., category VL includes ceilings $\geq$ 1000 feet but $<$ 3000 feet and/or visibility $\geq$ 2 miles but $<$ 3 miles). Using this scheme, a "persistence forecast" is defined as a forecast that the future ceiling/visibility

category will be the same as the initial ceiling/visibility category. In [4] a similar scheme is employed using combined ceiling/visibility categories but the limits are much broader than those in [5]. For example, category III in [4] includes ceilings $\geq$ 1500 feet but < 5000 feet and all visibilities $\geq$ 3 miles.

2. Static Persistence of Ceiling vs Cloud Height. In studies dealing with cloud forecasts, the distinction is made by the author (but may be missed by the reader) that verification figures on "persistence" refer to cloud forecasts which include heights of scattered clouds as well as ceiling heights. In such studies [3], results concerning the value of persistence forecasts cannot be compared directly with results from studies dealing only with ceilings. The authors of this paper feel that there is a difference in the cloud height variability between scattered clouds and ceilings. Results from a separate investigation indicate that the one-hour cloud height variability of scattered clouds is less than the variability of ceilings at the same height, and therefore, the inclusion of scattered clouds in the data groupings would produce higher verification scores for this type of persistence forecast.

3. Trend Persistence. Verification scores from trend persistence forecasts represent the percent accuracy attained by assuming "no-change" in an established trend in values (or categories) as determined by comparing the initial observation with a series of previously recorded observations. It is recognized that trend persistence is referred to by other names in the literature, such as "extrapolation" in [10] or simply "trend" in [3]. The fact remains, however, that many forecasters who do use this forecast tool refer to the technique as "persistence." It certainly differs from static persistence, but it is another type of a no-change forecast. For example, if the ceiling has been lifting at a certain rate for a period of time, say for the past two hours, many forecasters will predict a higher ceiling during the next hour and the reason often given is that they are using "persistence." Trend persistence has been used both as an evaluation tool and forecast aid. In [3] it is described as an evaluation tool, where it is compared with static persistence and other techniques. In [10] and [11], it is applied as a forecast aid. The results from [10] and [11], however, are based on extremely limited samples of data.

It is apparent from the previous discussion that one must accept conclusions from the variety of published studies with a certain degree of qualification. If a particular evaluation study draws the general conclusion that "persistence is the best forecast," the investigator may have been referring to a comparison with static category-persistence using exceptionally broad combined ceiling/visibility categories, and/or the comparison may have been made only between overall

percent-correct scores. Persistence may not have been the best forecast for certain restricted ceiling or visibility conditions. The following conclusion, published a few years ago in a widely disseminated publication [12], is a typical example of an unqualified statement concerning persistence forecasts, without any explanation concerning the specific type of persistence forecast, amount of data used, or method of evaluation. On the other hand, the statement may actually be only an expression of personal opinion without support of results from any investigation. The statement is "...it is generally acknowledged that forecasts of 0 to 2 hours can usually not be made which are more accurate than persistence. This means if knowledge about elements in this short time range is needed it is best to use the current observation for the forecast." Most forecasters are aware of this statement since this publication is available in every forecasting detachment. It has special interest in 4 Wea Wg since the preparation of 1-2 hour forecasts is a routine forecast responsibility. As a result of such unqualified statements in the literature, it is not surprising, therefore, to find many forecasters who blindly accept the premise that persistence forecasting cannot be surpassed, and tend to rely excessively upon persistence while ignoring other meteorological tools.

A need exists for a comprehensive analysis on the value of all types of persistence forecasts, in which a complete spectrum of initial ceiling and visibility conditions are investigated using a large sample of data. An attempt is made in this paper to provide reliable quantitative estimates on the value of static persistence and trend persistence of separate ceiling and visibility values and categories using a long period of record.

SECTION II - DATA

In order to keep the study to a manageable size, an attempt was made to obtain the most representative data for the study. A series of stations was chosen across the country which not only had a long period of record of surface observations on magnetic tape, but were also representative of the weather regimes of their particular locations. A total of seven stations were chosen. These are listed in Table I. Surface weather observations on magnetic tape were obtained from the Environmental Technical Applications Center (ETAC) for each station. This data consisted of card images of hourly surface observations. The total number of observations for a given station varied from 100,000 to 175,000, depending on the period of record. It must be emphasized that only hourly observations were considered in the study. No special or local surface observations were available on magnetic tape.

Values of ceiling and visibility were reported in accordance with the Manual of Surface

Observations (WBAN), Circular N. Minor changes in reportable values of visibility were made through the years, but these are inconsequential to the study. Ceiling values have always followed a standard reporting format.

TABLE 1: List of stations and period of record used in study.

Location Identifier	Station Name	Period of Record
COS	Colorado Springs, Colorado	July 1948-December 1964
OAF	Oxnard AFB, California	April 1944-June 1965
FMH	Otis AFB, Massachusetts	October 1942-June 1965
PAM	Tyndall AFB, Florida	August 1945-July 1965
DLH	Duluth IAP, Minnesota	January 1948-December 1963
SRF	Hamilton AFB, California	July 1945-June 1965
GVW	Richards-Gebaur AFB, Missouri	April 1954-June 1965

SECTION III - METHOD OF DEVELOPMENT

A. Ceiling and Visibility Values.

1. To evaluate static persistence, each initial hourly observation was compared to the observation one hour later.

2. To evaluate trend persistence, each initial hourly observation was compared to the two hourly observations immediately preceding and the observation one hour later.

a. One-hour ceiling value trends were computed by subtracting the ceiling height of the previous hour from the initial ceiling height. In this way, a one-hour ceiling trend was established. This is referred to as one-hour trend of ceiling values. The direction of the trend was verified by comparing the initial ceiling value with the ceiling value one hour later. The one-hour trend of visibility values was calculated in the same manner.

b. Two-hour ceiling trends were computed by further subtracting the two-hour previous

ceiling height from the one-hour previous ceiling height. Together with the one-hour trend, this is referred to as two-hour trend of ceiling values. This was again compared to the ceiling observation one hour after initial time. The two-hour trend of visibility values was calculated in the same manner.

Ceiling and Visibility Categories.

Prior to analysis, all ceiling values were classed into eight ceiling categories (A-H) and all visibility values were classed into eight visibility categories (J-Q).

1. To evaluate static persistence of ceiling categories and visibility categories, the initial category was compared to the category one hour later.

2. The one-hour and two-hour trend of ceiling categories and visibility categories was computed using the technique described earlier.

Processing of ceiling and visibility data was accomplished through computer techniques. Data were sequence checked to insure that the hourly trends were valid. The trend computation was omitted when either one or two hours of data was missing prior to the initial observation, or missing one hour following the initial observation. For this reason, minor differences occur between the total number of ceiling observations and the total number of visibility observations for the same station. However, the percentage values are correctly calculated, based upon the actual number of observations considered.

SECTION IV - RESULTS

A. General.

With any statistical study, the question arises concerning the size of the data base. Tables 2 and 3 list the frequency of initial hourly ceiling heights and the number of initial hourly visibility values respectively for each station used in the study. From these values the computations of static persistence, one-hour trend persistence and two-hour trend persistence were made. These two tables are also an indication of the ceiling/visibility climatology of the station. Given the total number of observations during the indicated period of record, the percentage frequency of occurrence of specified hourly observations is tabulated.

Depiction of results in a statistical study is a major problem. With large amounts of data,

TABLE 2: Frequency of specified ceilings reported on hourly observations during period of record at selected terminals.

Ceiling (feet)	COS		OAF		FMH		PAM		DLH		SRF		GVW	
	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%
0-100	816	0.6	2843	2.4	6126	3.9	3150	1.8	4593	3.3	2522	1.4	968	1.0
200-400	2104	1.5	3665	3.0	10944	6.9	3437	2.0	6344	4.5	2814	1.6	2457	2.5
500-900	3038	2.1	7751	6.4	10461	6.5	5175	3.0	8666	6.2	8852	5.1	4005	4.0
1000-1400	2152	1.5	5471	4.5	5079	3.2	3715	2.1	7125	5.1	7081	4.0	2815	2.9
1500-2900	4669	3.2	7990	6.6	9124	5.7	9811	5.6	11389	8.1	12164	7.0	6134	6.2
3000-4900	4882	3.4	4161	3.4	9174	5.8	6183	3.5	10033	7.2	6140	3.5	4946	5.0
5000-9500	11782	8.1	2284	1.9	12228	7.7	9177	5.3	10070	7.2	4352	2.5	8461	8.6
≥10000	114986	79.6	87034	71.8	95772	60.3	133947	76.7	81794	58.4	131223	74.9	68810	69.8
TOTAL	144429	100%	121198	100%	158908	100%	174595	100%	140014	100%	175148	100%	98596	100%
Period of Record	7/48-12/64		4/44-6/65		10/42-6/65		8/45-7/65		1/48-12/63		7/45-6/65		4/54-6/65	

TABLE 3: Frequency of specified visibilities reported on hourly observations during period of record at selected terminals.

	COS		OAF		FMH		PAM		DLH		SRF		GVW	
Visibility (st. miles)	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%
0-3/8	995	0.7	2658	2.2	5835	3.7	3230	1.9	4218	3.0	3427	2.0	1150	1.2
1/2-7/8	1049	0.7	1995	1.7	4596	2.9	1288	0.7	2270	1.6	1339	0.8	988	1.0
1-1 7/8	1266	0.9	4828	4.0	7302	4.6	1629	0.9	3579	2.6	3394	1.9	1932	2.0
2-2 1/2	943	0.7	5496	4.5	6271	4.0	1474	0.8	2997	2.1	3205	1.8	1626	1.7
3-4	1722	1.2	11391	9.4	12212	7.7	4278	2.4	4657	3.3	8160	4.7	3446	3.5
5-6	1786	1.2	13533	11.2	12130	7.6	7900	4.5	3427	2.5	7628	4.3	3290	3.3
7-9	1936	1.3	24917	20.5	14843	9.3	40481	23.2	4781	3.4	20946	12.0	6748	6.8
≥10	134724	93.3	56351	46.5	95739	60.2	114307	65.6	114081	81.5	127053	72.5	79416	80.5
TOTAL	144421	100%	121169	100%	158928	100%	174587	100%	140010	100%	175152	100%	98596	100%
Period of Record	7/48-12/64		4/44-6/65		10/42-6/65		8/45-7/65		1/48-12/63		7/45-6/65		4/54-6/65	

some method of display must be chosen to best illustrate the main points of the study. In this study, a total of six types of persistence are considered, namely: static persistence, one-hour and two-hour trend persistence of ceiling values and visibility values, and static persistence, one-hour and two-hour trend persistence of ceiling categories and visibility categories. This results in 12 sets of computation for each of the seven stations considered. It was decided to portray the results both graphically and on special tables to best answer the question, "Given an initial ceiling or visibility condition, or an established one-hour or two-hour trend, what percentage of the time will this condition (or trend) persist for the next hour?"

However, a discussion of 84 individual graphs and 28 tables is prohibitive, so it was decided to construct composite graphs and tables of each type of persistence. This resulted in 12 mean graphs (six covering ceiling and six covering visibility) and four mean tables (two covering ceiling and two covering visibility). All of these were computed from over one million hourly observations. The discussion will center on these mean charts with comments directed to individual stations only when there are significant deviations. The graphs and tables for each individual station are found in the Appendices.

B. Description of Tables 4 Through 7.

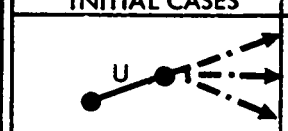
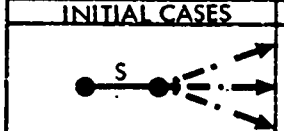
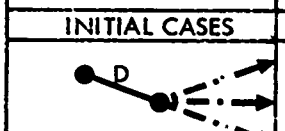
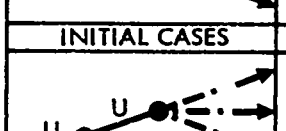
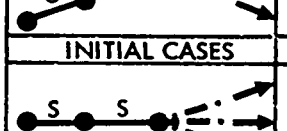
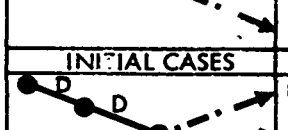
1. Table 4 shows for all stations combined, the percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly trends (viz., no trend, U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later was at least 100 feet higher, the same value, or at least 100 feet lower than the initial value. To facilitate the portrayal of data, the initial ceiling values have been grouped by certain ranges. For example, the column labeled 1000-1400 feet is used to summarize the results from individual initial ceiling values of 1000 feet, 1100 feet, 1200 feet, 1300 feet or 1400 feet.

a. NO TREND. This section of the table shows for each initial ceiling value, the percentage of time that the ceiling value one hour later was higher (U), the same (S) and lower (D), regardless of the previous ceiling trend. The row labeled "S" therefore represents the STATIC PERSISTENCE of ceiling values. The number of cases processed are shown in the last row of the section. For example, consider the column "1500-2900." There were a total of 61,281 initial hourly observations in which the initial ceiling value was 1500 feet, 1600 feet, ... or 2900 feet. In 43% of these cases, the ceiling one hour later was at least 100 feet higher, the ceiling value one hour later was exactly the same in 29% of the cases, and during the remaining 28% of the time, the

TABLE 4: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION: ALL STATIONS	PREVIOUS TRENDS (INITIAL)	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET) 0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10,000	All Ceilings
NO TREND		U	33	41	42	44	43	36	29	4	14
		S	61	38	31	28	29	36	43	86	71
		D	6	21	27	28	28	28	28	10	15
	INITIAL CASES		21018	31765	47948	33438	61281	45519	58354	713566	1012889
1-HR UP TREND	U	U	43	52	51	52	48	39	33	8	28
		S	44	31	26	24	25	31	37	70	47
		D	13	17	23	24	27	30	30	22	25
	INITIAL CASES		1278	7017	13549	10814	19405	13355	12833	65691	143942
1-HR STEADY TREND	S	U	31	37	38	40	40	33	28	2	7
		S	65	46	38	37	37	43	48	90	83
		D	4	17	24	23	23	24	24	8	10
	INITIAL CASES		12784	12612	15531	9647	17640	15446	24079	614042	722581
1-HR DOWN TREND	D	U	37	39	40	42	43	36	29	24	35
		S	55	36	29	25	26	33	41	47	37
		D	8	25	31	33	31	31	30	29	28
	INITIAL CASES		6956	12136	18868	12977	24236	16718	20642	33833	146366
2-HR UP TREND	U U	U	--	57	56	58	52	41	35	8	33
		S	--	29	24	22	23	30	36	70	44
		D	--	14	20	20	25	29	29	22	23
	INITIAL CASES		--	1333	4151	3841	7386	4882	3336	16603	41532
2-HR STEADY TREND	S S	U	29	33	34	36	36	32	27	2	4
		S	69	50	44	43	42	47	52	92	89
		D	2	17	22	21	22	21	21	6	
	INITIAL CASES		8438	6013	6332	3819	6892	7730	11022	552308	6025
2-HR DOWN TREND	D D	U	36	39	38	41	40	34	28	24	36
		S	44	35	28	23	24	31	40	46	33
		D	20	26	34	36	36	35	32	30	31
	INITIAL CASES		2681	4895	7209	4631	7822	5348	4893	4018	41497

TABLE 5: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down) this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

STATION: ALL STATIONS	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL VISIBILITY VALUE (ST. MILES)								
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10	All Visibilities
NO TREND		U	43	48	47	42	39	37	28	6	13
		S	44	28	29	33	38	38	52	84	74
		D	13	24	24	25	23	25	20	10	13
	INITIAL CASES		21513	13525	23930	22012	45866	49694	114652	721671	1012863
1-HR UP TREND		U	54	57	56	51	49	49	39	16	31
		S	28	22	22	28	32	31	43	70	53
		D	18	21	22	21	19	20	18	14	16
	INITIAL CASES		2910	3468	6694	6470	11837	12825	20392	70678	135274
1-HR STEADY TREND		U	37	42	41	35	32	31	24	4	8
		S	54	38	39	43	47	47	59	87	82
		D	9	20	20	22	21	22	17	9	10
	INITIAL CASES		9383	3923	7390	7707	19765	21888	73878	607741	751675
1-HR DOWN TREND		U	46	47	42	40	37	34	27	16	29
		S	38	26	31	28	46	32	45	56	45
		D	16	27	27	32	17	34	28	28	26
	INITIAL CASES		9220	6134	9846	7835	14264	14981	20382	43252	125914
2-HR UP TREND		U	57	59	60	56	54	53	43	19	35
		S	19	17	19	24	30	29	42	68	51
		D	24	24	21	20	16	18	15	13	14
	INITIAL CASES		300	720	1884	2249	4166	4487	7057	20574	41437
2-HR STEADY TREND		U	35	34	38	29	30	26	21	4	6
		S	59	48	45	50	52	54	63	88	85
		D	6	18	17	21	18	20	16	8	9
	INITIAL CASES		5098	1569	3121	3534	10499	11957	53353	531876	621007
2-HR DOWN TREND		U	46	47	45	40	36	34	26	15	34
		S	37	26	26	27	32	33	43	59	38
		D	17	27	29	33	32	33	31	26	28
	INITIAL CASES		4746	2902	4192	3019	4878	3969	3630	5734	33070

ceiling value one hour later was at least 100 feet lower.

b. ONE-HOUR TREND. Three sections of the table show the results of including the one-hour trend in ceiling values from the previous hour (t_{-1}) to the initial hour (t_o). The "1-HR Up Trend" section shows for each initial ceiling value, the percentage of time that the ceiling value one hour after initial time (t_{+1}) was higher (U), the same (S), and lower (D) than the initial value during all conditions when the ceiling had improved at least 100 feet during the past hour (from t_{-1} to t_o). The "1-HR Steady Trend" section shows for each initial ceiling value, the percentage of the time that the ceiling value one hour later was U, S, and D during all conditions when the ceiling value remained exactly the same during the past hour. The "1-HR Down Trend" section shows for each initial ceiling value, the percentage of time that the ceiling value one hour later was U, S, or D during all conditions when the ceiling had lowered at least 100 feet during the past hour. Since all initial ceiling conditions are preceded by a U, S, or D trend, the sum of the initial cases from the three one-hour trend sections will be equal to the total number of cases in the "NO TREND" section for each initial ceiling value.

c. TWO-HOUR TREND. Three sections of the table show the results of including the two-hour trend in ceiling values as determined from t_{-2} to t_{-1} and from t_{-1} to t_o. Although nine combinations of two-hour trends (viz., UU, US, UD, SU, SS, SD, DU, DS and DD) were computed in this study, only three of these trends are included in Table 4 in order to evaluate trend persistence. Those listed in Table 4 are UU, SS, and DD, or situations where the direction of the trend was the same during the previous two hours.

2. Table 5 shows for all stations combined, the percentage frequency of one-hour changes in visibility values from an initial visibility value. This table is interpreted in the same manner as Table 4.

3. Table 6 shows for all stations combined, the percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends, this table shows the percentage of time that the ceiling category one hour later improved to at least one category higher (U), remained the same (S), or lowered to at least one category lower. The interpretation of Table 6 is similar to Table 4 except that ceiling categories are used instead of ceiling values. In the "NO TREND" section, the row of percentages in the row labeled "S" represents the STATIC PERSISTENCE of ceiling categories. In order to appreciate the differences between Table 6 and Table 4, consider the following example from the "NO TREND"

TABLE 6: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down) this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

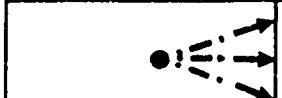
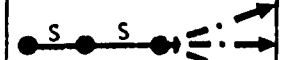
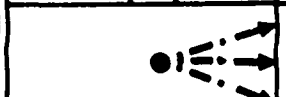
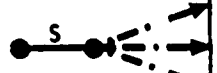
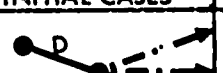
STATION: ALL STATIONS	PREVIOUS TRENDS (INITIAL)	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)								
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000	All Categories
NO TREND		U	28	30	26	32	26	25	21	--	8
		S	72	61	62	52	62	58	63	95	85
		D	--	9	12	16	12	17	16	5	7
	INITIAL CASES		21018	31765	47948	33438	61281	45519	58354	713566	1012889
1-HR UP TREND		U	--	32	28	35	24	24	21	--	13
		S	--	56	58	48	57	52	54	81	67
		D	--	12	14	17	19	24	25	19	20
	INITIAL CASES		--	3364	5801	6284	8439	7837	7530	37270	76525
1-HR STEADY TREND		U	25	27	24	29	23	23	20	--	5
		S	75	65	66	57	66	62	67	95	90
		D	--	8	10	14	11	15	13	5	5
	INITIAL CASES		15325	19831	30497	17979	38030	26043	37216	676296	861217
1-HR DOWN TREND		U	35	34	32	34	33	30	26	--	31
		S	65	55	54	46	54	54	61	--	56
		D	--	11	14	20	13	16	13	--	13
	INITIAL CASES		5693	8570	11650	9175	14812	11639	13608	--	75147
2-HR UP TREND		U	--	--	35	45	29	26	23	--	13
		S	--	--	55	37	54	46	51	82	68
		D	--	--	10	18	17	28	26	18	19
	INITIAL CASES		--	--	536	640	1338	857	1201	5562	10134
2-HR STEADY TREND		U	24	26	22	27	21	22	18	--	4
		S	76	67	69	60	68	64	68	96	96
		D	--	7	9	13	11	14	14	4	4
	INITIAL CASES		11503	13097	20391	10509	25210	15469	25127	642929	764235
2-HR DOWN TREND		U	34	34	31	35	31	27	--	--	32
		S	66	56	56	43	54	54	--	--	55
		D	--	10	13	22	15	19	--	--	13
	INITIAL CASES		1298	1868	2418	1407	1819	964	--	--	9774

TABLE 7: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: ALL STATIONS	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL VISIBILITY CATEGORY (ST. MILES)								
			J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	All Categories
NO TREND		U	30	42	39	38	32	32	24	--	7
		S	70	40	45	40	50	47	60	96	86
		D	--	18	16	22	18	21	16	4	7
	INITIAL CASES		21513	13525	23930	22012	45866	49694	114652	721671	1012863
1-HR UP TREND		U	--	52	46	46	40	41	31	--	23
		S	--	32	37	34	43	41	53	88	62
		D	--	16	17	20	17	18	16	12	15
	INITIAL CASES		--	2565	4398	5155	8772	9833	15837	29140	75700
1-HR STEADY TREND		U	26	36	35	32	28	27	21	--	4
		S	74	48	51	49	56	55	65	96	91
		D	--	16	14	19	16	18	14	4	5
	INITIAL CASES		14888	5580	11452	9600	25194	27000	81994	692531	868239
1-HR DOWN TREND		U	39	42	39	39	34	33	24	--	33
		S	61	37	40	34	43	41	53	--	47
		D	--	21	21	27	23	26	23	--	20
	INITIAL CASES		6625	5380	8000	7257	11900	12861	16821	--	68924
2-HR UP TREND		U	--	--	46	53	43	47	34	--	24
		S	--	--	36	32	44	38	52	89	63
		D	--	--	18	15	13	15	14	11	13
	INITIAL CASES		--	--	567	982	2200	2388	4130	6098	16365
2-HR STEADY TREND		U	25	32	32	28	26	24	19	--	3
		S	75	55	56	54	59	58	68	96	93
		D	--	13	12	18	15	18	13	4	4
	INITIAL CASES		10612	2725	6243	5097	15634	16863	62404	659285	778863
2-HR DOWN TREND		U	38	42	39	39	31	30	--	--	36
		S	62	38	41	35	45	42	--	--	45
		D	--	20	20	26	24	28	--	--	19
	INITIAL CASES		2676	1947	2584	1926	2707	1704	--	--	13544

sections of the tables. Suppose the initial ceiling was 600 feet and one hour later the ceiling increased to 800 feet. In Table 6, this individual case was included in the "S" row (62% figure) or STATIC PERSISTENCE of ceiling categories, since the initial category was category C and remained category C. In Table 4, however, this individual case was included in the "U" row (42% figure) since the ceiling value was at least 100 feet higher one hour later. Throughout Table 6, the reader must remember that the frequency of one-hour changes refer specifically to category changes.

4. Table 7 shows for all stations combined, the percentage frequency of one-hour changes in visibility categories from an initial visibility category. It is interpreted in the same manner as Table 6.

C. Description of Figures 1 and 2.

1. Figure 1 shows graphically for all stations combined, a comparison of Static Persistence, Overall 1-Hour Trend Persistence, and Overall 2-Hour Trend Persistence for ceiling values (Figure 1A) and ceiling categories (Figure 1B). This figure summarizes in graphical form, much of the ceiling information found in Table 4 and Table 6.

a. The "Static Persistence" curves in Figures 1A and 1B are simply a plot of the percentage values from the "S" row of the "NO TREND" sections of Table 4 and Table 6 respectively. Both curves provide a reliable quantitative estimate of the value of static persistence of ceiling values and ceiling categories for different initial ceiling conditions.

b. The "1-Hour Trend Persistence" curves were constructed using an overall "percent agreement" value computed from the three 1-Hour Trend sections of Table 4 and Table 6. The values plotted in Figure 1 are not readily apparent in Table 4 and Table 6, therefore, some further discussion is warranted. A specific value on the curves represents the percentage of time that the past one-hour trend (U, S, or D) continued for one hour (e.g., U→U, S→S and D→D). An example will illustrate the computation of the plotted values. Consider the value of 40% in Figure 1A for initial ceiling values between 1500 feet-2900 feet. From Table 4, 48% of the 1-Hour Up Trends continued up; 37% of the 1-Hour Steady Trends continued steady; and 31% of the 1-Hour Down Trends continued down. Combining these three values yields the 40% (overall agreement) value plotted in Figure 1A. The values in Figure 1B were computed in the same manner.

c. The "2-Hour Trend Persistence" curves were computed from the three 2-Hour Trend sections of Table 4 and Table 6. A specific value on the curves represents the percentage of time that the past two-hour trend (UU, SS, or DD) continued for one hour (e.g., UU→U, SS→S, and DD→D).

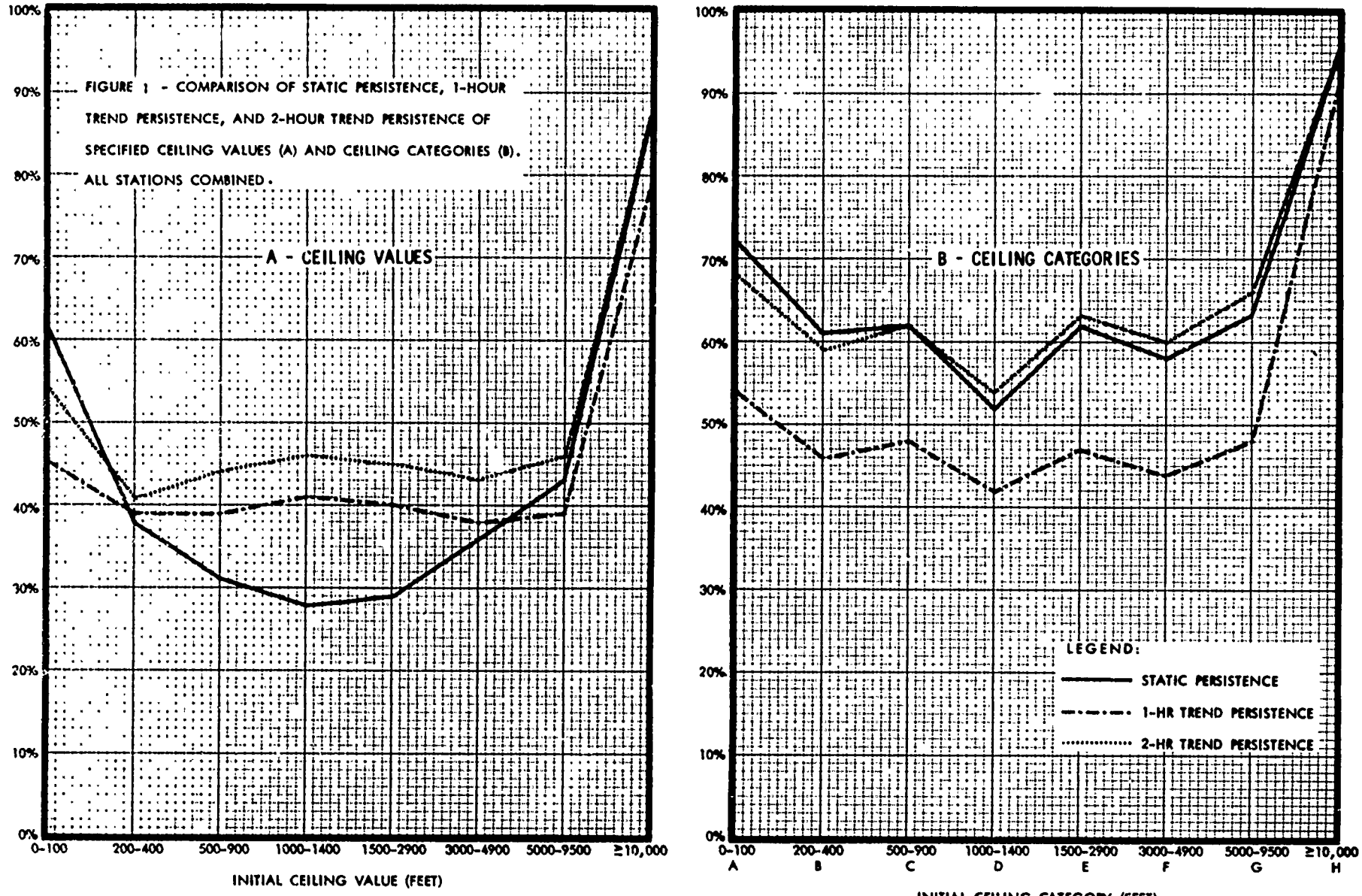


FIGURE 1 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED CEILING VALUES (A) AND CEILING CATEGORIES (B). ALL STATIONS COMBINED.

2. Figure 2 shows graphically for all stations combined, a comparison of Static Persistence, Overall 1-Hour Trend Persistence, and Overall 2-Hour Trend Persistence for visibility values (Figure 2A) and visibility categories (Figure 2B). Figure 2 summarizes much of the visibility information found in Table 5 and Table 7. The same techniques were used in constructing Figure 2 as used in Figure 1.

D. Discussion of Results.

An attempt to discuss in detail each of the individual graphs and tables in the Appendices is beyond the scope of this paper. Small scale variations occur among individual stations due primarily to local influences. These in themselves are interesting but only the results common to most stations will be discussed in this section.

1. Ceiling Persistence (Figure 1, Table 4, and Table 6).

a. Static persistence of ceiling values is below 50% between 200 feet and 10,000 feet for all stations. The minimum persistence probability appears to be around 1000-1400 feet. The very low percentage (less than 20%) in the 1000-2900 foot range at both Colorado Springs and Duluth was an unexpected result, since the climatic regimes of the two stations are so different. In comparison, static persistence of ceiling categories is about 60% between 200 feet and 10,000 feet. This illustrates the higher verification scores obtained when ceiling categories are used. The scores would be even higher if the categories were broader.

b. The one-hour trend persistence for initial ceiling values between 200 feet and 10,000 feet is much higher than static persistence, but the two-hour trend does not offer much improvement over the one-hour trend. All trends for initial ceiling values between 200 feet and 10,000 feet, however, show less than 50% persistence probability.

c. For ceiling categories, one-hour trend persistence is worse than static persistence for all initial ceiling categories. The two-hour trend persistence is approximately the same as static persistence.

d. It is worthwhile to note the similarity in all the graphs of ceiling persistence probability regardless of geographic location.

e. In Table 4 and Table 6, the last column shows the overall results of combining all initial ceiling values (or categories). Note the overall static persistence scores. For ceiling values the overall score is 71%, and for ceiling categories it is 85%. In many studies these are

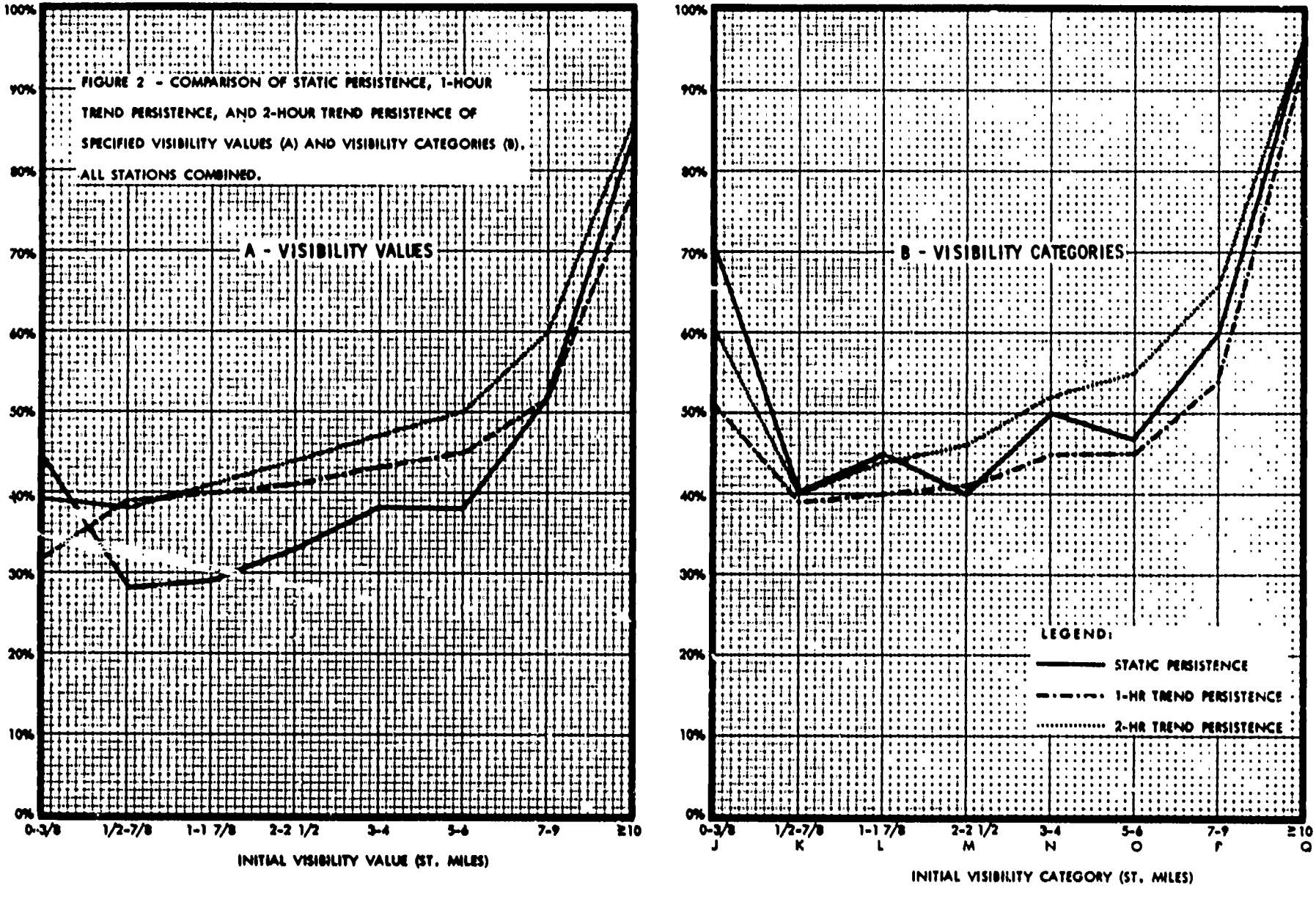


FIGURE 2 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED VISIBILITY VALUES (A) AND VISIBILITY CATEGORIES (B). ALL STATIONS COMBINED.

the only scores used for evaluating persistence forecasts. Note the significant decrease in scores for ceilings below 10,000 feet.

2. Visibility Persistence (Figure 2, Table 5, and Table 7).

a. As might be expected, the highest static persistence of visibility values occurs for initial visibilities greater than 10 miles. With the exception of Colorado Springs and Duluth (where the least static persistence occurs between 5 and 6 miles), the lowest static persistence scores occur between 1/2 mile and 7/8 mile. In nearly all cases, static persistence of visibility values is less than 50% for all initial visibilities less than seven miles.

b. Both the one-hour and two-hour trends of visibility values are generally greater than static persistence, but the two-hour trend is not significantly higher than the one-hour trend.

c. Considering visibility categories, there are, in general, small differences among static, one-hour trend, and two-hour trend. As might be expected, the static persistence of visibility categories is higher than the static persistence of visibility values, but the difference is not so striking as that between ceiling values and ceiling categories.

d. From Table 5 and Table 7, the overall static persistence is 74% for visibility values and 86% for visibility categories. Note the significant decrease in scores for visibilities below 10 miles.

SECTION V - SUMMARY AND CONCLUSIONS

In this paper an attempt has been made to describe some of the various applications of persistence by different meteorological agencies, to identify areas of confusion and clarify the definition of the general term "persistence," and finally to present a statistical evaluation of the value of persistence in one-hour forecasting based upon a large sample of data. Over a million hourly observations from seven terminals were processed through computer techniques in order to obtain a reliable evaluation of static and trend persistence for a wide spectrum of initial ceiling and visibility conditions. The results for each individual station were practically identical, therefore, the results portrayed in the composite graphs and tables may be used as a reliable measure of the value of persistence.

Concerning static persistence forecasts, results of this study confirm prior conclusions that the overall percent accuracy is rather high when all ceilings and all visibilities are grouped

together. However, for initial ceilings between 200-10000 feet and for initial visibilities between 1/2-9 miles, the percent accuracy for static persistence is exceptionally low. The lowest one-hour ceiling persistence probability occurs with initial ceilings between 1000-2900 feet, where the persistence probability is approximately 30% for ceiling values and about 50% for ceiling categories. The lowest one-hour visibility persistence probability occurs with initial visibilities primarily between 1/2-7/8 mile, and secondarily between 5-6 miles, where the persistence probability is again about 30% for values and near 40% for categories.

The inclusion of one-hour past trends is an improvement over static persistence when dealing with ceiling and visibility values but it should be noted that the inclusion of two-hour trends does not offer much additional improvement. When dealing with categories instead of values, the inclusion of past trends offers little if any improvement over static persistence. It is interesting to note that if only the one-hour ceiling category trend is considered, the verification scores are actually worse than static persistence.

The fact that previous forecast verification studies have drawn conclusions that the skill of forecasters, or of a particular method, was worse than persistence may be explained by any or all of the following reasons. Some investigators, in an attempt to simplify the number of statistical manipulations, may possibly have selected ceiling and visibility categories which were too broad, thereby masking out the fine differences between certain ranges of ceiling and visibility. The use of combined ceiling and/or visibility categories causes a further increase in persistence scores making it increasingly difficult to surpass persistence. Some investigators may have compared only the general overall percent accuracy for all ceilings and all visibilities combined. The use of such general verification scores will seldom show any significant improvement over persistence because of the majority of high ceilings and visibilities which indeed have high persistence probabilities.

In light of the results from this study, it is difficult to accept the premise that persistence is always the "best" forecast in short period forecasting, particularly during the periods of highly variable ceilings and visibilities such as those found when ceilings are below 3000 feet or visibilities below 3 miles. It is true that these weather conditions occur less than 25% of the time (see Table 2 and Table 3), but on the other hand, these are periods of greater importance for air operations, and are periods where the greatest forecast skill is needed. The results from this study show that the blind use of persistence (either static or trend) during these periods will yield exceptionally poor results in the one-hour prediction of ceiling or visibility.

Perhaps sufficient attention has not been directed toward the use of other forecast tools (e.g., local analysis and met-watch procedures) or toward the development of new one-hour prediction methods because of mistaken beliefs on the value of persistence. If this is the case, it is hoped that this paper will help restore interest in other existing tools and create an incentive to search for new one-hour prediction techniques.

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APPENDIX A

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

COLORADO SPRINGS, COLORADO

TABLE 8: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

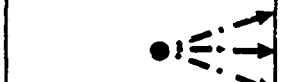
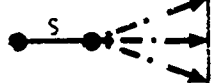
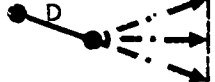
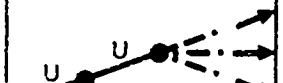
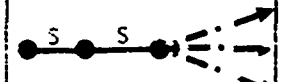
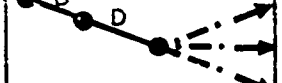
STATION: COS	PREVIOUS TRENDS (INITIAL)	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET) 0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000	All Ceilings
NO TREND		U	38	46	48	49	45	40	38	6	13
		S	56	33	22	18	19	29	43	84	73
		D	6	21	30	33	36	31	19	11	14
	INITIAL CASES		816	2104	3038	2152	4669	4882	11782	114986	144429
1-HR UP TREND		U	36	51	54	56	51	45	44	13	27
		S	51	28	20	17	16	26	34	64	49
		D	13	21	26	27	33	29	22	23	24
	INITIAL CASES		45	423	966	752	1567	1391	1982	11649	18775
1-HR STEADY TREND		U	33	40	43	50	43	37	37	3	6
		S	62	41	30	22	28	37	49	89	85
		D	5	19	27	28	29	26	14	8	9
	INITIAL CASES		458	693	679	389	906	1445	5075	96173	105818
1-HR DOWN TREND		U	45	47	47	44	42	38	37	29	36
		S	48	30	20	17	18	27	41	44	35
		D	7	23	33	39	40	35	22	27	29
	INITIAL CASES		313	988	1393	1011	2196	2046	4725	7164	19836
2-HR UP TREND		U	--	57	56	61	54	46	46	12	30
		S	--	28	16	16	17	24	30	65	45
		D	--	15	28	23	29	30	24	23	25
	INITIAL CASES		--	68	289	268	607	601	454	2787	5074
2-HR STEADY TREND		U	30	35	40	42	39	34	37	2	3
		S	67	45	38	22	33	41	51	91	90
		D	3	20	22	36	28	25	12	7	7
	INITIAL CASES		286	282	205	86	259	665	2209	85491	89483
2-HR DOWN TREND		U	48	43	44	47	40	38	36	27	38
		S	47	30	19	12	16	26	39	46	30
		D	5	27	37	41	44	36	25	27	32
	INITIAL CASES		133	452	665	449	914	887	1095	1141	5736

TABLE 9: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

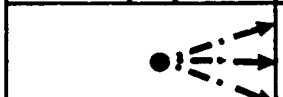
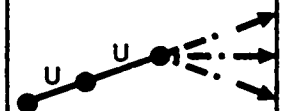
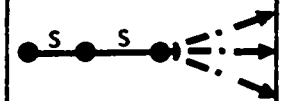
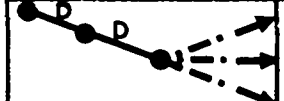
STATION: COS	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL VISIBILITY VALUE (ST. MILES)								
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10	All Visibilities
NO TREND		U	43	47	50	45	50	49	47	11	13
		S	47	36	28	29	23	20	24	76	73
		D	10	17	22	26	27	31	29	13	14
	INITIAL CASES		995	1049	1266	943	1722	1786	1936	134724	144421
1-HR UP TREND		U	57	49	52	50	53	52	54	23	27
		S	29	30	25	27	22	18	22	59	54
		D	14	21	23	23	25	30	24	18	19
	INITIAL CASES		94	186	292	244	613	744	772	16513	19458
1-HR STEADY TREND		U	34	38	45	38	46	44	43	9	10
		S	59	47	36	38	28	27	31	81	79
		D	7	15	19	24	26	29	36	10	11
	INITIAL CASES		468	378	357	269	391	363	469	103017	105712
1-HR DOWN TREND		U	50	53	51	47	49	47	42	12	20
		S	38	30	25	24	20	19	22	67	58
		D	12	17	24	29	31	34	36	21	22
	INITIAL CASES		433	485	617	430	718	679	695	15194	19251
2-HR UP TREND		U	50	50	53	61	55	57	57	26	31
		S	12	22	18	24	24	19	21	56	50
		D	38	28	29	15	21	24	22	18	19
	INITIAL CASES		8	18	55	54	159	259	310	4493	5356
2-HR STEADY TREND		U	33	24	43	33	52	36	32	9	9
		S	62	61	41	39	31	36	40	82	81
		D	5	15	16	28	17	28	28	9	10
	INITIAL CASES		276	175	130	101	108	98	145	83034	84067
2-HR DOWN TREND		U	49	53	55	46	47	47	38	16	28
		S	36	30	23	22	18	22	26	59	47
		D	15	17	22	32	35	31	36	25	25
	INITIAL CASES		207	217	289	170	275	240	199	2698	4295

TABLE 10: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

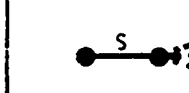
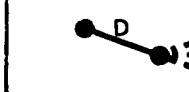
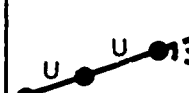
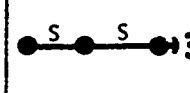
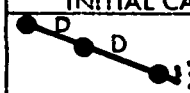
STATION: COS	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET)								
				A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000	All Categories
NO TREND			U	32	33	33	37	28	27	28	--	6
			S	68	59	52	41	55	55	64	96	88
			D	--	8	15	22	17	18	8	4	6
		INITIAL CASES		816	2104	3038	2152	4669	4882	11782	114986	144429
1-HR UP TREND			U	--	29	31	40	27	26	27	--	12
			S	--	59	51	39	50	49	51	81	68
			D	--	12	18	21	23	25	22	19	20
		INITIAL CASES		--	166	501	483	755	776	822	5073	8576
1-HR STEADY TREND			U	28	30	31	35	26	24	27	--	4
			S	72	62	55	45	58	59	66	96	92
			D	--	8	14	20	16	17	7	4	4
		INITIAL CASES		551	1230	1588	887	2581	2689	7584	109913	127023
1-HR DOWN TREND			U	42	40	37	36	32	32	28	--	32
			S	58	52	49	39	52	50	65	--	55
			D	--	8	14	25	16	18	7	--	13
		INITIAL CASES		265	708	949	782	1333	1417	3376	--	8830
2-HR UP TREND			U	--	--	25	42	36	25	35	--	15
			S	--	--	67	36	50	47	37	81	65
			D	--	--	8	22	14	28	28	19	20
		INITIAL CASES		--	--	36	64	146	96	123	558	1023
2-HR STEADY TREND			U	25	29	31	34	24	24	27	--	2
			S	75	63	59	46	60	60	67	97	94
			D	--	8	10	20	16	16	6	3	4
		INITIAL CASES		398	762	870	399	1509	1595	4993	105828	116354
2-HR DOWN TREND			U	38	41	34	37	30	32	--	--	35
			S	62	52	48	36	52	49	--	--	49
			D	--	7	18	27	18	19	--	--	16
		INITIAL CASES		72	192	273	166	231	178	--	--	1112

TABLE 11: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: COS	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL VISIBILITY CATEGORY (ST. MILES)								
			J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	All Categories
NO TREND		U	34	41	45	44	44	42	42	--	3
		S	66	47	38	32	33	31	32	99	95
		D	--	12	17	24	23	27	26	1	2
	INITIAL CASES		995	1049	1266	943	1722	1786	1936	134724	144421
1-HR UP TREND	U	U	--	46	44	49	48	45	48	--	28
		S	--	36	34	30	31	29	29	86	53
		D	--	18	22	21	21	26	23	14	19
	INITIAL CASES		--	121	232	231	516	625	684	1665	4074
1-HR STEADY TREND	S	U	28	35	41	37	39	36	38	--	1
		S	72	55	44	39	40	39	40	99	98
		D	--	10	15	24	21	25	22	1	1
	INITIAL CASES		660	494	477	302	570	560	623	133059	136745
1-HR DOWN TREND	D	U	45	47	48	46	46	44	40	--	45
		S	55	40	34	28	28	27	27	--	33
		D	--	13	18	26	26	29	33	--	22
	INITIAL CASES		335	434	557	410	636	601	629	--	3602
2-HR UP TREND	U U	U	--	--	33	61	49	53	51	--	25
		S	--	--	33	29	33	28	29	87	59
		D	--	--	34	10	18	19	20	13	16
	INITIAL CASES		--	--	18	31	103	167	224	589	1132
2-HR STEADY TREND	S S	U	26	28	38	35	42	34	32	--	1
		S	74	62	49	41	42	40	47	99	98
		D	--	10	13	24	16	26	21	1	1
	INITIAL CASES		475	275	211	119	229	216	252	131635	133412
2-HR DOWN TREND	D D	U	41	48	50	47	41	35	--	--	45
		S	59	39	34	31	31	30	--	--	37
		D	--	13	16	22	28	35	--	--	18
	INITIAL CASES		120	154	199	116	127	89	--	--	805

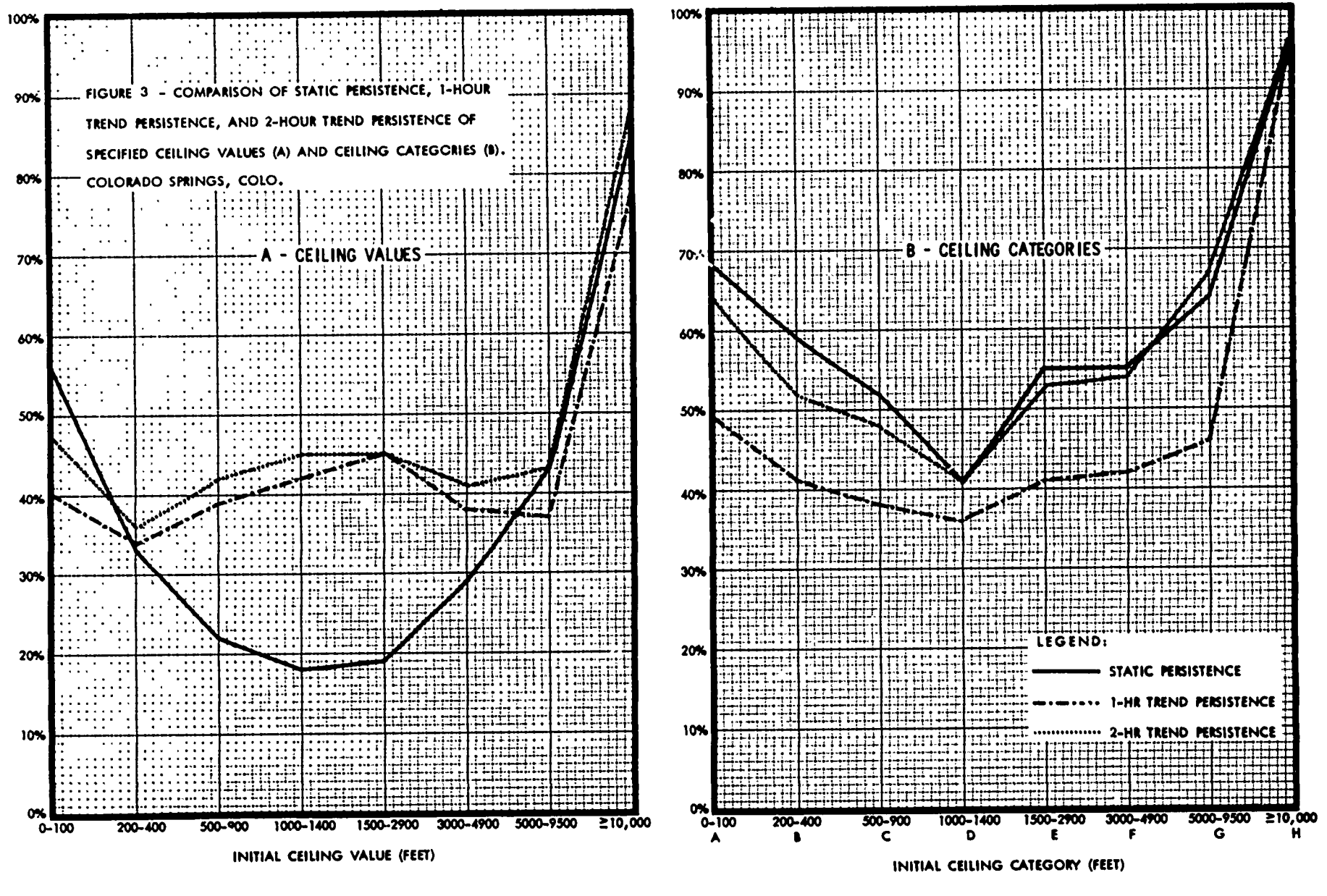


FIGURE 3 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED CEILING VALUES (A) AND CEILING CATEGORIES (B). COLORADO SPRINGS, COLO.

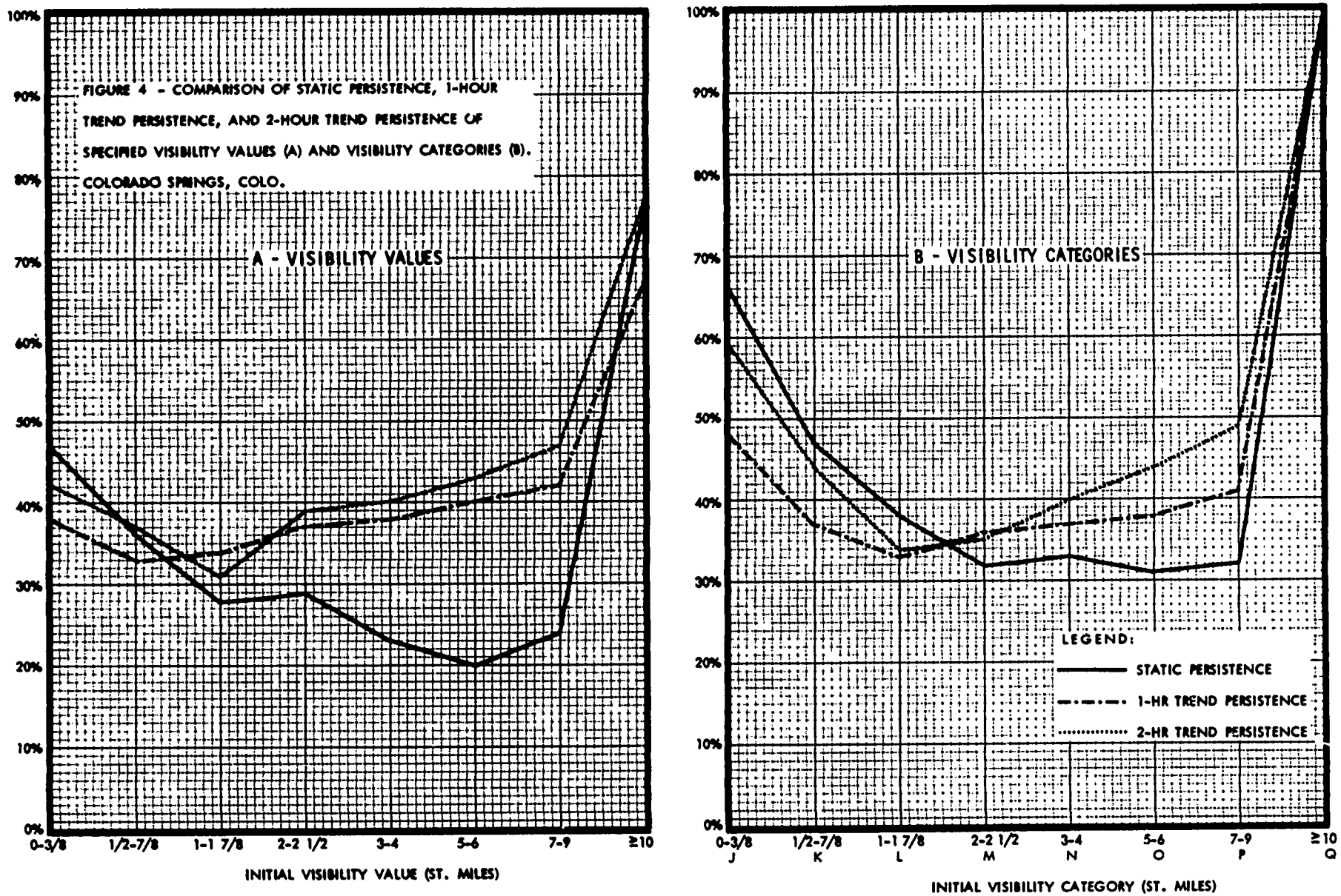


FIGURE 4 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED VISIBILITY VALUES (A) AND VISIBILITY CATEGORIES (B). COLORADO SPRINGS, COLO.

APPENDIX B

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

OXNARD AFB, CALIFORNIA

TABLE 12: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

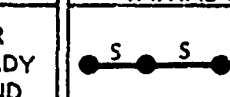
STATION: OAF	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET) 0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000	All Ceilings
NO TREND			U	33	39	39	42	43	32	26	2	12
			S	62	40	38	36	35	42	48	91	77
			D	5	21	23	22	22	26	26	7	11
	INITIAL CASES			2843	3665	7751	5471	7990	4161	2284	87034	121199
1-HR UP TREND			U	51	60	57	54	48	34	27	4	32
			S	37	30	29	29	30	38	41	79	49
			D	12	10	14	17	22	28	32	17	19
	INITIAL CASES			163	858	2056	722	2620	1304	456	5538	147717
1-HR STEADY TREND			U	32	36	33	36	39	29	27	1	6
			S	65	47	45	46	42	47	53	93	86
			D	3	17	22	18	19	24	20	6	8
	INITIAL CASES			1747	1484	2978	1982	2759	1773	1103	79471	93297
1-HR DOWN TREND			U	31	28	30	37	43	33	25	25	33
			S	60	40	39	33	31	39	45	29	41
			D	9	32	31	30	26	28	30	16	26
	INITIAL CASES			933	1323	2717	1767	2611	1084	725	2025	13185
2-HR UP TREND			U	--	68	68	61	52	36	22	4	38
			S	--	27	24	26	27	38	47	83	46
			D	--	5	8	13	21	26	31	13	16
	INITIAL CASES			--	186	720	684	1036	486	111	1566	4789
2-HR STEADY TREND			U	32	34	30	32	34	28	25	1	3
			S	67	49	49	52	49	51	56	94	91
			D	1	17	21	16	17	21	19	5	6
	INITIAL CASES			1134	697	1330	916	1170	896	480	73907	80530
2-HR DOWN TREND			U	26	28	30	36	40	28	25	25	32
			S	24	42	40	32	28	38	43	53	40
			D	10	30	30	32	32	34	33	22	28
	INITIAL CASES			374	484	877	480	671	259	120	157	3422

TABLE 13: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

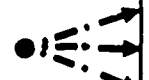
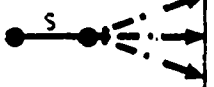
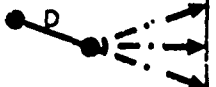
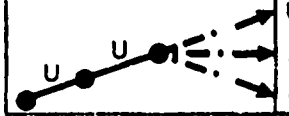
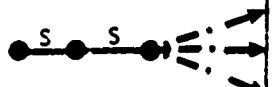
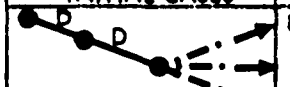
STATION: OAF	PREVIOUS TRENDS / INITIAL	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES) 0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10	All Visibilities
NO TREND		U	47	47	44	38	30	26	13	8	17
		S	41	32	33	40	51	53	74	77	66
		D	12	21	23	22	19	21	13	15	17
	INITIAL CASES		2658	1995	4828	5496	11391	13533	24917	56351	121169
1-HR UP TREND		U	58	62	63	55	43	41	26	18	34
		S	25	23	21	33	45	48	61	68	53
		D	17	15	16	12	12	11	13	14	13
	INITIAL CASES		409	560	1498	1701	2803	3096	3460	7776	21303
1-HR STEADY TREND		U	42	43	37	34	27	23	11	7	13
		S	52	40	43	47	56	58	77	80	73
		D	6	17	20	19	17	19	12	13	14
	INITIAL CASES		1099	633	1578	2179	5787	7201	18322	43419	80218
1-HR DOWN TREND		U	47	40	35	28	21	19	13	7	20
		S	37	30	33	36	46	48	66	66	52
		D	16	30	32	36	33	33	21	27	28
	INITIAL CASES		1150	802	1752	1616	2801	3236	3135	5156	19648
2-HR UP TREND		U	59	64	69	62	49	46	30	18	39
		S	18	25	18	29	41	44	59	69	50
		D	23	11	13	9	10	10	11	13	11
	INITIAL CASES		51	138	516	752	1142	1110	1281	2240	7230
2-HR STEADY TREND		U	40	41	31	29	25	20	10	6	10
		S	57	46	50	52	58	61	79	81	77
		D	3	13	19	19	17	19	11	13	13
	INITIAL CASES		571	255	685	1033	3245	4176	14145	34662	58772
2-HR DOWN TREND		U	44	42	35	26	23	21	14	7	25
		S	39	30	32	37	45	48	62	64	46
		D	17	28	33	37	32	31	24	29	29
	INITIAL CASES		664	409	813	635	917	733	627	808	5605

TABLE 14: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: OAF	PREVIOUS TRENDS / INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET) A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000	All Categories
NO TREND		U	28	28	23	27	22	18	18	--	7
		S	72	62	69	63	70	68	66	96	88
		D	--	10	8	10	8	14	16	4	5
	INITIAL CASES		2843	3665	7751	5471	7990	4161	2284	87034	121199
1-HR UP TREND	U	U	--	38	33	32	20	18	14	--	14
		S	--	55	61	59	67	63	61	86	73
		D	--	7	6	9	13	19	25	14	13
	INITIAL CASES		--	426	773	893	942	722	324	3811	7891
1-HR STEADY TREND	S	U	28	28	21	25	20	16	18	--	5
		S	72	64	72	66	74	71	68	96	90
		D	--	8	7	9	6	13	14	4	5
	INITIAL CASES		2062	2291	5444	3426	5603	2829	1510	83223	106388
1-HR DOWN TREND	D	U	29	23	22	30	32	25	22	--	27
		S	71	60	66	56	59	62	65	--	62
		D	--	17	12	14	9	13	13	--	11
	INITIAL CASES		781	948	1534	1152	1445	610	450	--	6920
2-HR UP TREND	U U	U	--	--	41	53	23	21	11	--	11
		S	--	--	56	40	61	50	59	92	79
		D	--	--	3	7	16	29	30	8	10
	INITIAL CASES		--	--	89	78	115	44	37	677	1040
2-HR STEADY TREND	S S	U	28	27	20	24	19	16	16	--	4
		S	72	66	74	67	76	73	71	96	92
		D	--	7	6	9	5	11	13	4	4
	INITIAL CASES		1441	1404	3699	2128	3989	1927	982	76626	92196
2-HR DOWN TREND	D D	U	30	22	25	26	39	17	--	--	27
		S	70	68	68	57	53	70	--	--	65
		D	--	10	7	17	8	13	--	--	8
	INITIAL CASES		169	153	177	106	88	30	--	--	723

TABLE 15: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: OAF	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL VISIBILITY CATEGORY (ST. MILES)								
				J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	All Categories
NO TREND			U	31	39	29	30	21	19	11	--	10
			S	69	45	59	54	66	67	78	94	81
			D	--	16	12	16	13	14	11	6	9
	INITIAL CASES			2658	1995	4828	5496	11391	13533	24917	56351	121169
1-HR UP TREND	U		U	--	54	42	42	26	27	17	--	21
			S	--	33	47	48	65	63	72	90	69
			D	--	13	11	10	9	10	11	10	10
	INITIAL CASES			--	398	771	1204	1777	2076	2861	3095	12182
1-HR STEADY TREND	S		U	29	36	28	28	20	18	10	--	7
			S	71	52	62	58	68	69	80	95	85
			D	--	12	10	14	12	13	10	5	8
	INITIAL CASES			1829	904	2836	2946	7526	9040	19469	53256	97806
1-HR DOWN TREND	D		U	35	34	24	22	18	16	11	--	20
			S	65	43	58	48	59	61	74	--	61
			D	--	23	18	30	23	23	15	--	19
	INITIAL CASES			829	693	1221	1346	2088	2417	2587	--	11181
2-HR UP TREND	U U		U	--	--	47	50	33	35	20	--	24
			S	--	--	41	45	61	56	71	90	67
			D	--	--	12	5	6	9	9	10	9
	INITIAL CASES			--	--	133	238	523	423	623	620	2560
2-HR STEADY TREND	S S		U	28	35	26	26	19	16	9	--	6
			S	72	55	64	60	69	70	80	95	87
			D	--	10	10	14	12	14	11	5	7
	INITIAL CASES			1291	475	1761	1720	5157	6248	15501	50483	82636
2-HR DOWN TREND	D D		U	32	35	25	22	20	19	--	--	25
			S	68	37	57	47	57	56	--	--	55
			D	--	28	18	31	23	25	--	--	20
	INITIAL CASES			401	246	434	357	475	268	--	--	2181

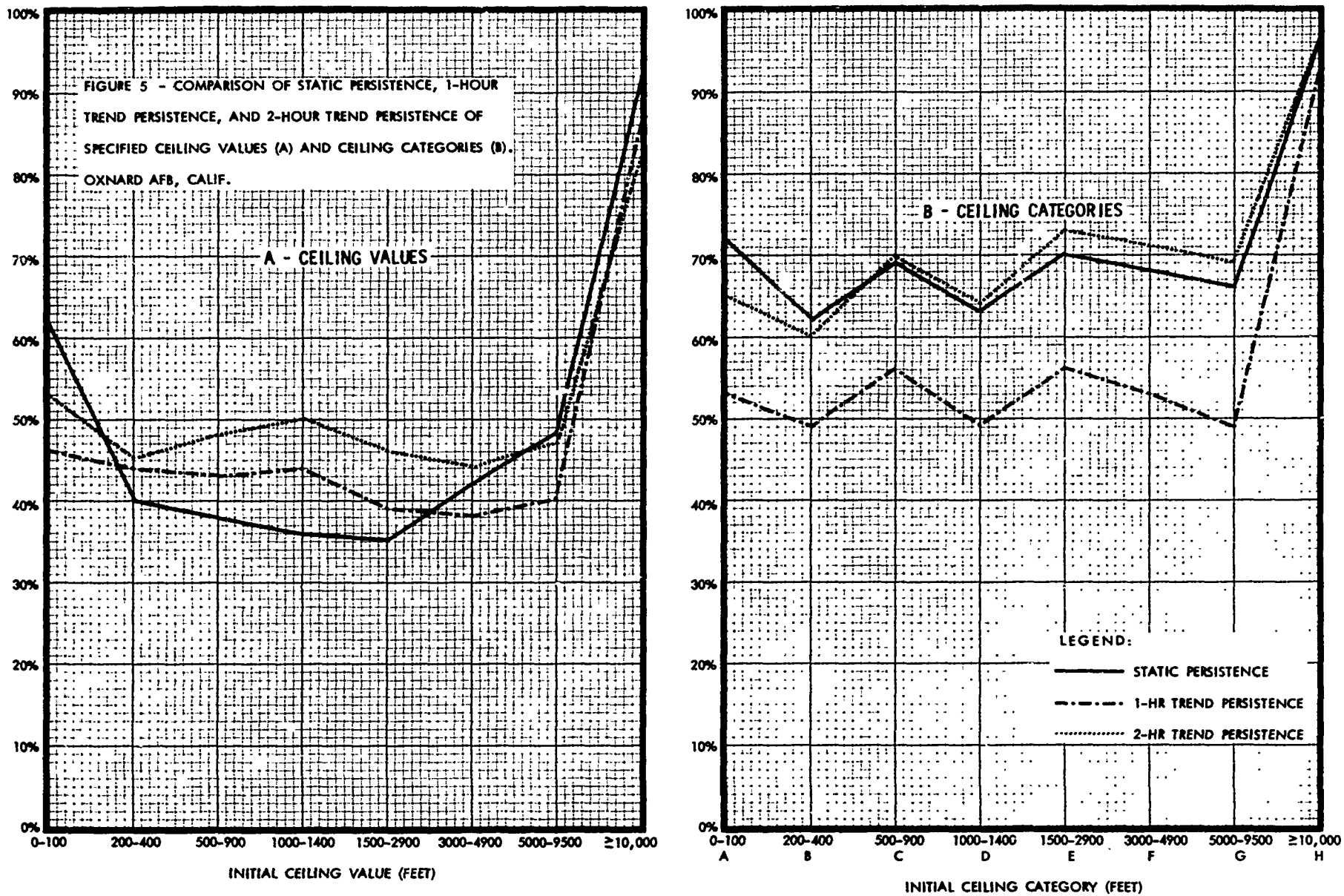


FIGURE 5 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED CEILING VALUES (A) AND CEILING CATEGORIES (B). OXNARD AFB, CALIF.

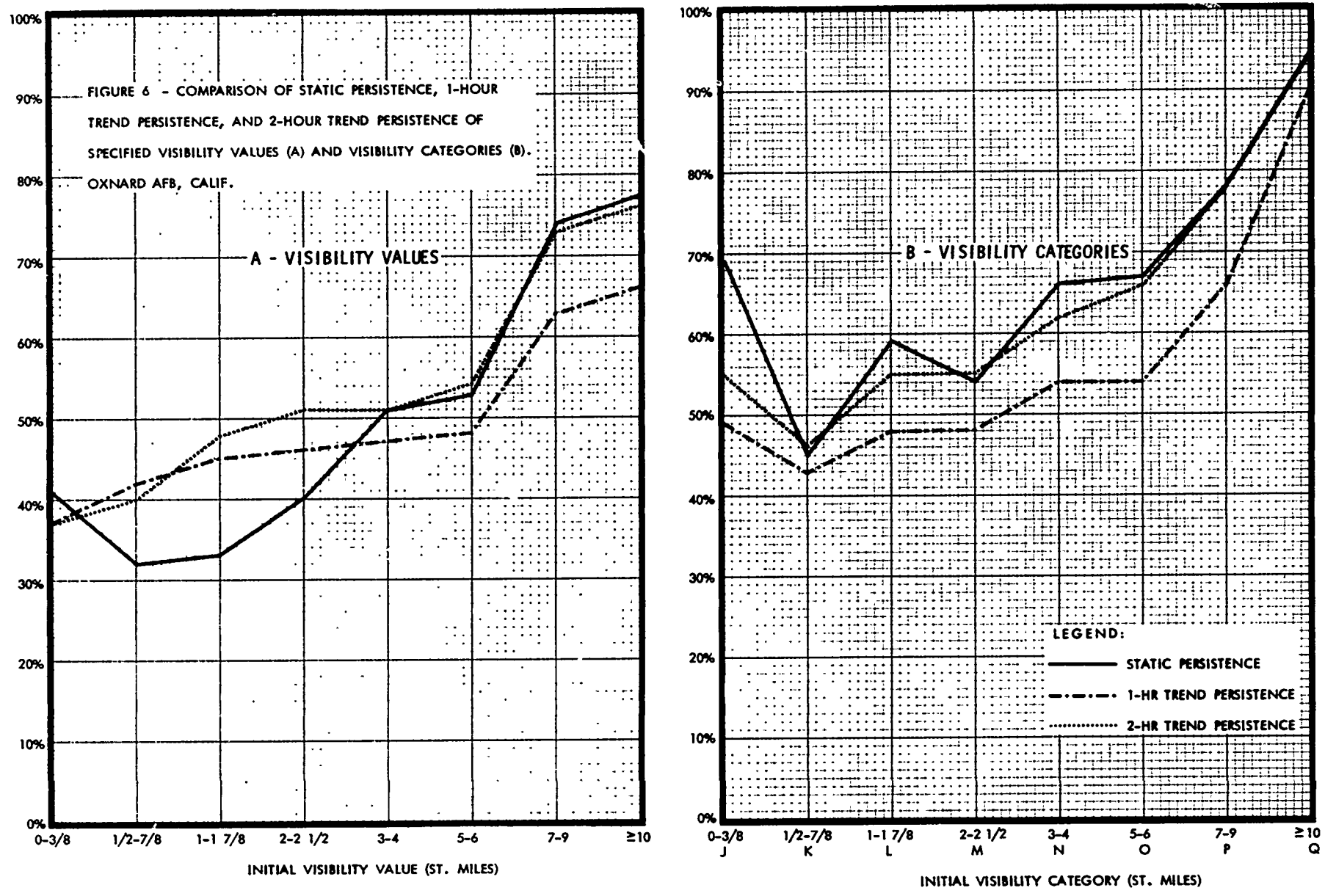


FIGURE 6 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED VISIBILITY VALUES (A) AND VISIBILITY CATEGORIES (B). OXNARD AFB, CALIF.

APPENDIX C

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

OTIS AFB, MASSACHUSETTS

TABLE 16: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

STATION: FMH	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)								
				0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000	All Ceilings
NO TREND			U	33	32	34	35	36	32	25	4	15
			S	60	46	36	35	36	42	47	84	68
			D	7	22	30	30	28	26	28	12	17
	INITIAL CASES			6126	10944	10461	5079	9124	9174	12228	95772	158908
1-HR UP TREND	U		U	48	43	43	42	41	35	28	7	26
			S	38	37	29	30	32	36	42	70	49
			D	14	20	28	28	27	29	30	23	25
	INITIAL CASES			409	2145	2920	1543	2468	2123	2522	9537	23667
1-HR STEADY TREND	S		U	30	29	29	31	32	31	22	2	9
			S	65	53	45	45	45	49	51	88	79
			D	5	18	26	24	23	20	27	10	12
	INITIAL CASES			3694	5072	3779	1765	3306	3889	5788	80933	108226
1-HR DOWN TREND	D		U	35	31	32	34	35	33	25	22	30
			S	56	42	32	28	31	38	45	53	42
			D	9	27	36	38	34	29	30	25	28
	INITIAL CASES			2023	3727	3762	1771	3350	3162	3918	5302	27015
2-HR UP TREND	U U		U	--	52	48	47	47	39	33	7	31
			S	--	30	25	28	27	32	39	69	44
			D	--	18	27	25	26	29	28	24	25
	INITIAL CASES			--	386	889	550	855	581	667	2200	6128
2-HR STEADY TREND	S S		U	29	27	26	28	30	29	21	2	5
			S	68	57	52	50	49	53	55	90	85
			D	3	16	22	22	21	18	24	8	10
	INITIAL CASES			2414	2707	1711	794	1484	1913	2938	71431	85392
2-HR DOWN TREND	D D		U	33	29	28	31	32	29	21	20	28
			S	56	41	30	23	30	37	42	50	38
			D	11	30	42	46	38	34	37	30	34
	INITIAL CASES			799	1450	1412	634	1111	816	964	565	7751

TABLE 17: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

STATION: FMH	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES) 0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10	All Visibilities
NO TREND			U	43	42	40	36	30	27	24	4	15
			S	43	32	35	36	46	47	54	88	71
			D	14	26	25	28	24	26	22	8	14
	INITIAL CASES			5835	4596	7302	6271	12212	12130	14883	95739	158928
1-HR UP TREND	U		U	54	54	50	47	47	42	36	14	34
			S	27	23	28	28	34	38	45	74	48
			D	19	23	22	25	19	20	19	12	18
	INITIAL CASES			762	1139	1939	1815	3005	3205	3779	8200	23844
1-HR STEADY TREND	S		U	37	36	35	30	24	21	20	2	8
			S	54	43	45	47	55	57	61	91	82
			D	9	21	20	23	21	22	19	7	10
	INITIAL CASES			2496	1485	2539	2283	5650	5722	8002	84303	112480
1-HR DOWN TREND	D		U	46	40	39	32	26	23	19	14	29
			S	37	30	30	32	43	40	46	57	40
			D	17	30	31	36	31	37	35	29	31
	INITIAL CASES			2577	1972	2824	2173	3557	3203	3062	3236	22604
2-HR UP TREND	U U		U	64	60	54	50	51	47	42	17	37
			S	20	20	22	25	32	34	43	72	47
			D	16	20	24	25	17	19	15	11	16
	INITIAL CASES			74	221	491	578	1062	1176	1520	2972	8094
2-HR STEADY TREND	S S		U	35	31	29	26	22	18	17	2	5
			S	58	51	53	53	59	61	65	92	87
			D	7	18	18	21	19	21	18	6	8
	INITIAL CASES			1335	636	1145	1079	3112	3240	4903	76391	91841
2-HR DOWN TREND	D D		U	44	39	38	31	23	24	17	14	32
			S	38	31	31	32	43	39	42	56	37
			D	18	30	31	37	34	37	41	30	31
	INITIAL CASES			1297	903	1148	782	1184	894	589	195	6992

TABLE 18: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: FMH	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET) A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000	All Categories
NO TREND			U	26	22	21	27	23	24	18	--	9
			S	74	68	63	51	61	59	65	94	82
			D	--	10	16	22	16	17	17	6	9
	INITIAL CASES			6126	10944	10461	5079	9124	9174	12228	95772	158908
1-HR UP TREND	U		U	--	29	24	31	24	24	19	--	14
			S	--	56	56	46	54	52	55	81	65
			D	--	15	20	23	22	24	26	19	21
	INITIAL CASES			--	1027	1544	1107	1356	1363	1710	5929	14036
1-HR STEADY TREND	S		U	24	20	18	24	21	23	16	--	6
			S	76	71	67	57	65	62	68	95	86
			D	--	9	15	19	14	15	16	5	8
	INITIAL CASES			4521	7440	6590	2605	5534	5430	7973	89843	129936
1-HR DOWN TREND	D		U	31	25	26	29	29	26	23	--	27
			S	69	63	55	44	53	56	64	--	58
			D	--	12	19	27	18	18	13	--	15
	INITIAL CASES			1605	2477	2327	1367	2234	2381	2545	--	14936
2-HR UP TREND	U U		U	--	--	30	40	29	32	23	--	15
			S	--	--	51	38	51	46	54	82	65
			D	--	--	19	22	20	22	23	18	20
	INITIAL CASES			--	--	138	146	258	207	256	982	1987
2-HR STEADY TREND	S S		U	24	19	17	23	19	22	15	--	5
			S	76	73	70	60	68	65	69	95	89
			D	--	8	13	17	13	13	16	5	6
	INITIAL CASES			3417	5291	4434	1484	3606	3386	5397	85043	112058
2-HR DOWN TREND	D D		U	26	23	21	26	22	22	--	--	23
			S	74	64	56	40	57	59	--	--	59
			D	--	13	23	34	21	19	--	--	18
	INITIAL CASES			362	549	544	258	359	179	--	--	2251

TABLE 19: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: FMH	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL VISIBILITY CATEGORY (ST. MILES) J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	All Categories
NO TREND			U	30	36	32	31	25	22	19	--	10
			S	70	46	50	45	57	57	62	95	80
			D	--	18	18	24	18	21	19	5	10
	INITIAL CASES			5835	4596	7302	6271	12212	12130	14843	95739	158928
1-HR UP TREND	U		U	--	47	44	43	38	35	29	--	26
			S	--	33	38	35	44	46	54	88	57
			D	--	20	18	22	18	19	17	12	17
	INITIAL CASES			--	836	1352	1549	2320	2617	3150	4512	16336
1-HR STEADY TREND	S		U	27	33	28	27	21	19	17	--	6
			S	73	52	57	53	63	63	67	96	87
			D	--	15	15	20	16	18	16	4	7
	INITIAL CASES			4066	2099	3670	2796	6992	6853	9180	91227	126883
1-HR DOWN TREND	D		U	38	34	32	29	23	21	17	--	27
			S	62	44	46	40	54	50	54	--	50
			D	--	22	22	31	23	29	29	--	23
	INITIAL CASES			1769	1661	2280	1926	2900	2660	2513	--	15709
2-HR UP TREND	U U		U	--	--	47	47	40	43	35	--	26
			S	--	--	31	33	44	40	51	89	59
			D	--	--	22	20	16	17	14	11	15
	INITIAL CASES			--	--	170	320	614	729	1003	1502	4338
2-HR STEADY TREND	S S		U	26	30	25	24	18	16	15	--	4
			S	74	58	61	57	67	66	70	96	90
			D	--	12	14	19	15	18	15	4	6
	INITIAL CASES			2961	1095	2100	1471	4419	4329	6110	87254	109739
2-HR DOWN TREND	D D		U	37	33	29	30	19	23	--	--	29
			S	63	47	46	40	55	48	--	--	50
			D	--	20	25	30	26	29	--	--	21
	INITIAL CASES			712	602	729	512	688	404	--	--	3647

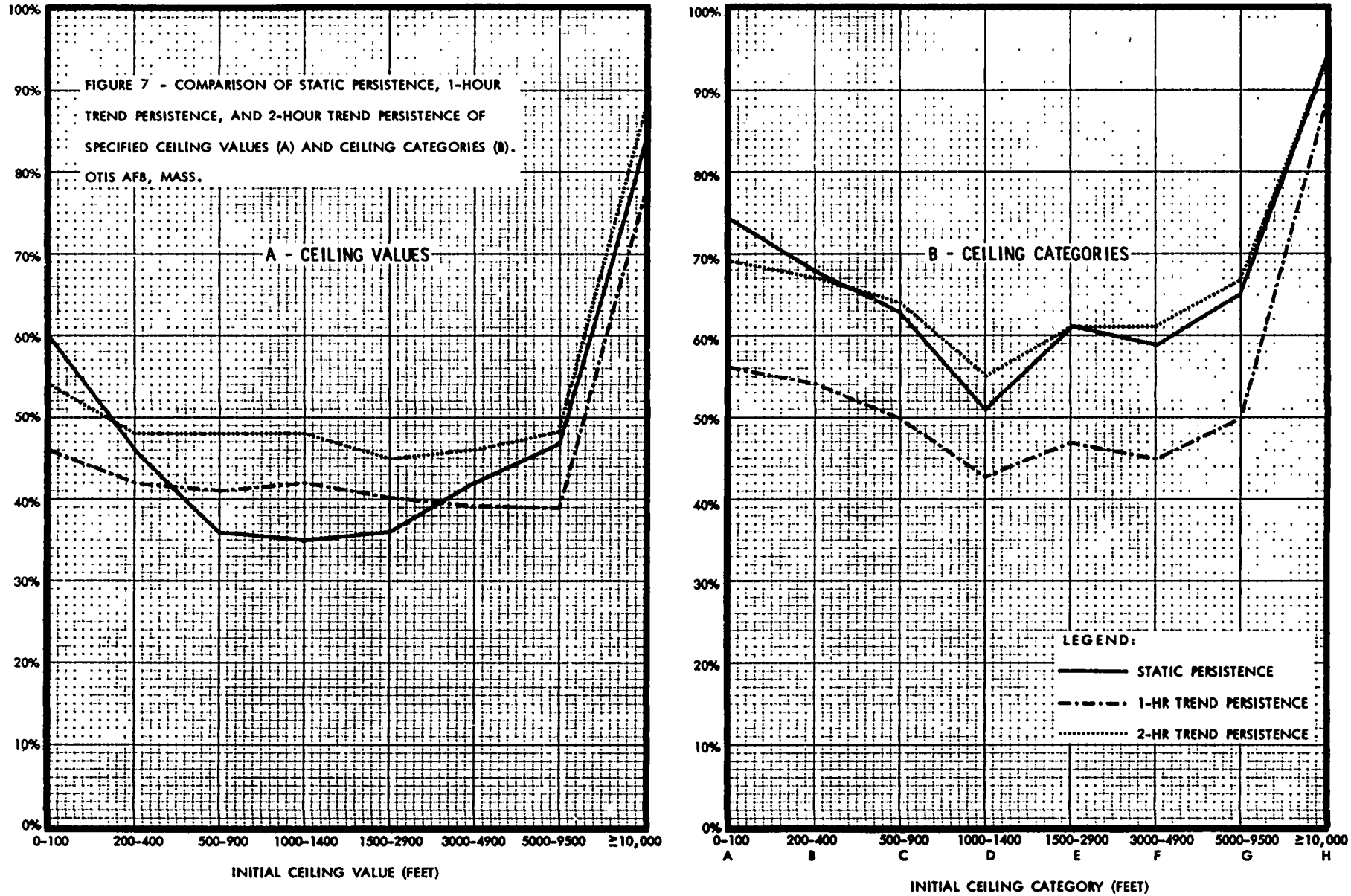


FIGURE 7 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED CEILING VALUES (A) AND CEILING CATEGORIES (B). OTIS AFB, MASS.

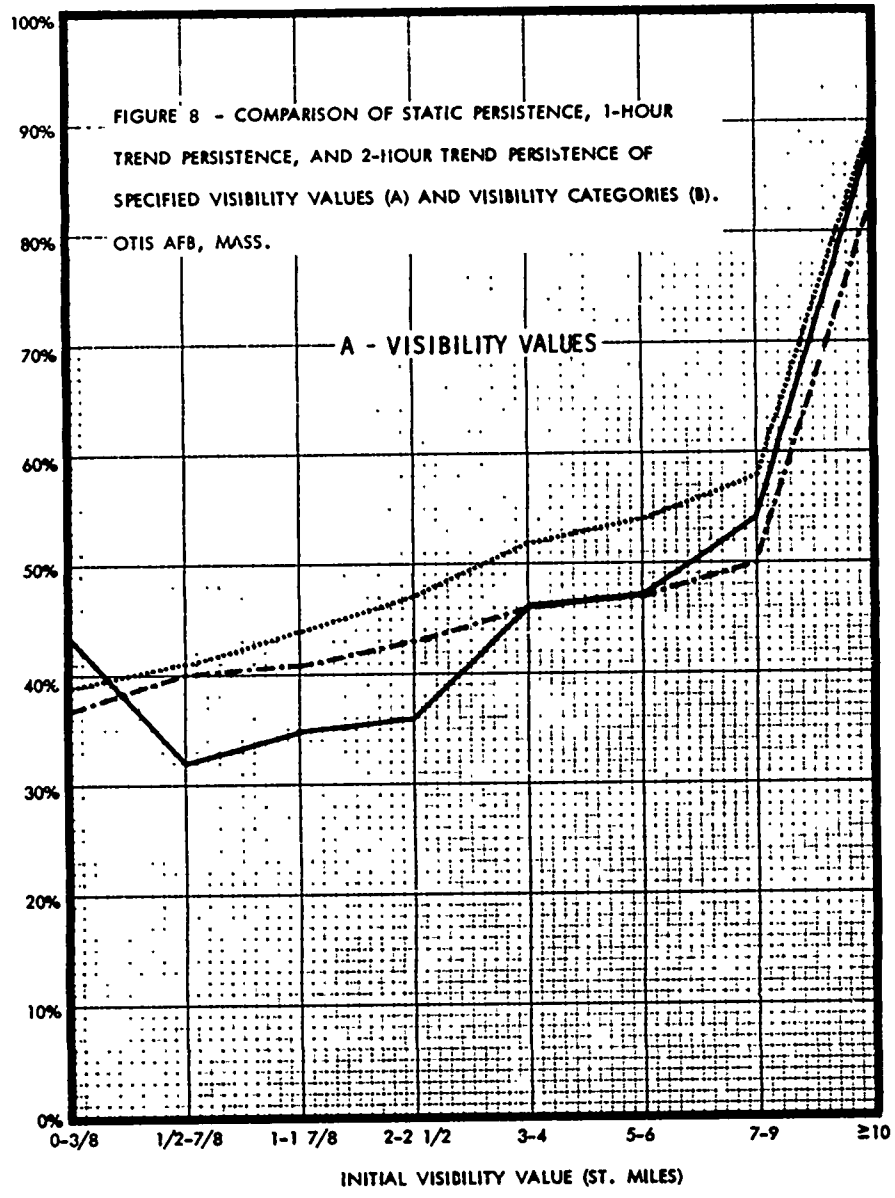
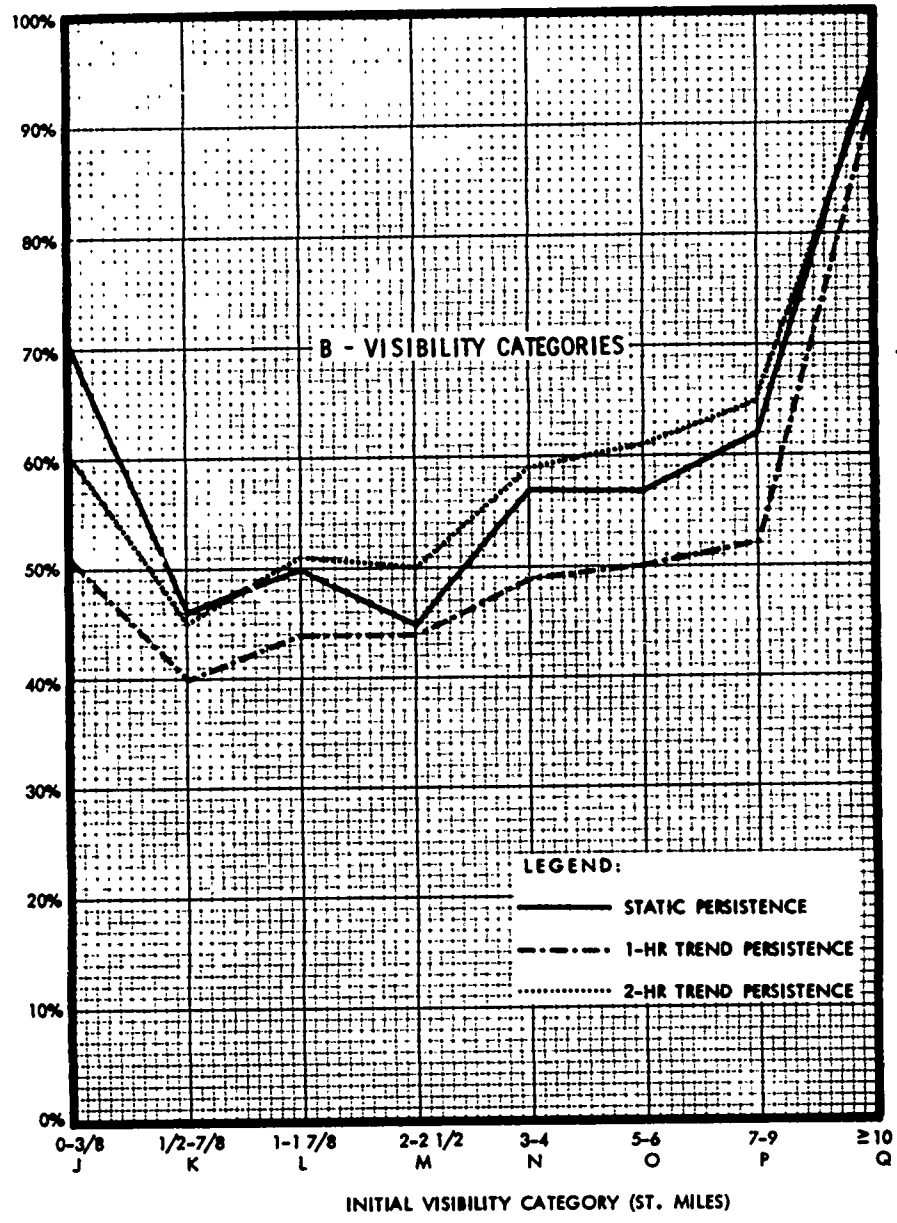


FIGURE 8 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED VISIBILITY VALUES (A) AND VISIBILITY CATEGORIES (B). OTIS AFB, MASS.



APPENDIX D

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

TYNDALL AFB, FLORIDA

TABLE 20: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

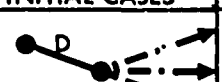
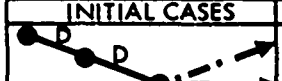
STATION: PAM	PREVIOUS TRENDS (INITIAL)	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET) 0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000	All Ceilings
NO TREND		U	37	49	46	49	46	32	25	4	14
		S	57	31	31	29	34	45	47	85	73
		D	6	20	23	22	20	23	28	11	13
	INITIAL CASES		3150	3437	5175	3715	9811	9183	9177	133947	174595
1-HR UP TREND		U	47	58	51	52	46	37	32	7	23
		S	34	24	25	25	29	38	38	70	54
		D	19	18	24	23	25	25	30	23	23
	INITIAL CASES		203	789	1286	992	2263	1402	2052	14016	23003
1-HR STEADY TREND		U	32	40	41	42	41	29	23	2	7
		S	65	42	39	41	41	51	52	89	83
		D	3	18	20	17	18	20	25	9	10
	INITIAL CASES		1808	1074	1575	1083	3281	2579	4411	113357	129168
1-HR DOWN TREND		U	43	50	48	52	50	33	25	20	40
		S	50	28	27	24	30	41	45	53	39
		D	7	22	25	24	20	26	30	27	21
	INITIAL CASES		1139	1574	2314	1640	4267	2202	2714	6574	22424
2-HR UP TREND		U	--	65	56	56	49	39	39	9	27
		S	--	22	24	20	27	38	37	66	50
		D	--	13	20	24	24	23	24	25	23
	INITIAL CASES		--	169	340	288	661	465	431	2833	5187
2-HR STEADY TREND		U	29	37	37	34	37	31	25	2	4
		S	69	46	44	50	48	52	56	91	88
		D	2	17	19	16	15	17	19	7	8
	INITIAL CASES		1169	455	622	445	1347	1605	1938	100182	107763
2-HR DOWN TREND		U	39	51	46	50	49	37	31	30	43
		S	52	27	26	24	27	36	46	49	34
		D	9	22	28	26	24	27	23	21	23
	INITIAL CASES		401	565	780	499	984	558	444	509	4740

TABLE 21: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down) this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

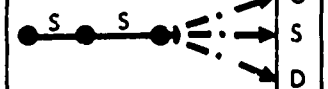
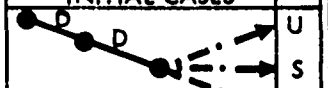
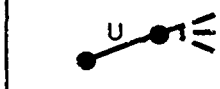
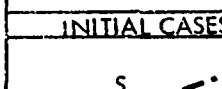
STATION: PAM	PREVIOUS TRENDS (INITIAL)	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES) 0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10	All Visibilities
NO TREND		U	46	53	57	52	48	43	17	2	10
		S	41	19	19	25	29	36	72	91	80
		D	13	28	24	23	23	21	11	7	10
	INITIAL CASES		3230	1288	1629	1474	4278	7900	40481	114307	174587
1-HR UP TREND		U	54	64	63	59	60	51	29	5	26
		S	27	13	14	19	23	29	56	84	60
		D	19	23	23	22	17	20	15	11	14
	INITIAL CASES		470	347	479	394	1077	1853	5552	8181	18353
1-HR STEADY TREND		U	39	46	53	42	37	17	14	2	6
		S	52	32	28	40	42	46	77	92	87
		D	9	22	19	18	21	17	9	6	7
	INITIAL CASES		1329	247	300	368	1247	2886	29140	104106	139623
1-HR DOWN TREND		U	49	51	56	54	48	43	22	6	34
		S	36	18	27	20	25	32	60	79	45
		D	15	31	27	26	27	25	18	15	21
	INITIAL CASES		1431	694	850	712	1954	3161	5789	2020	16611
2-HR UP TREND		U	60	61	73	66	64	58	35	9	32
		S	21	10	9	11	19	24	53	82	56
		D	19	29	18	23	17	18	12	9	12
	INITIAL CASES		47	77	130	109	319	546	1612	1838	4678
2-HR STEADY TREND		U	37	27	57	31	31	31	12	2	4
		S	56	49	30	53	50	55	80	92	89
		D	7	24	13	16	19	14	8	6	7
	INITIAL CASES		687	80	84	147	518	1337	22576	95641	121070
2-HR DOWN TREND		U	45	49	54	52	48	41	22	3	42
		S	39	19	19	23	24	32	55	78	33
		D	16	32	27	25	28	27	23	19	25
	INITIAL CASES		716	324	364	294	624	638	450	121	3531

TABLE 22: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: PAM	PREVIOUS TRENDS (INITIAL)	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET) A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9000	H ≥ 10000	All Categories
NO TREND		U	30	38	34	41	36	32	24	--	8
		S	70	50	55	43	53	53	61	94	85
		D	--	12	11	16	11	15	15	6	7
	INITIAL CASES		3150	3437	5175	3715	9811	6183	9177	133947	174595
1-HR UP TREND		U	--	36	35	42	32	30	27	--	13
		S	--	49	50	41	49	49	51	79	66
		D	--	15	15	17	19	21	22	21	21
	INITIAL CASES		--	435	631	711	1202	1020	1506	7644	13149
1-HR STEADY TREND		U	26	33	28	35	30	28	21	--	4
		S	74	56	61	51	60	58	66	95	90
		D	--	11	11	14	10	14	13	5	6
	INITIAL CASES		2195	1716	2832	1594	5230	3275	5616	126303	148761
1-HR DOWN TREND		U	41	46	43	48	45	38	30	--	41
		S	60	42	45	34	45	47	56	--	47
		D	--	12	12	18	10	15	14	--	12
	INITIAL CASES		955	1286	1712	1410	3379	1888	2055	--	12685
2-HR UP TREND		U	--	--	47	50	37	34	32	--	15
		S	--	--	38	27	44	46	51	77	64
		D	--	--	15	23	19	20	17	23	21
	INITIAL CASES		--	--	55	74	207	143	231	1042	1752
2-HR STEADY TREND		U	25	33	25	31	27	27	19	--	3
		S	75	57	65	57	64	60	68	96	93
		D	--	10	10	12	9	13	13	4	4
	INITIAL CASES		1630	961	1740	816	3109	1888	3697	120267	134108
2-HR DOWN TREND		U	38	52	47	49	38	37	--	--	44
		S	62	38	43	30	46	45	--	--	44
		D	--	10	10	21	16	18	--	--	12
	INITIAL CASES		226	283	360	228	295	115	--	--	1507

TABLE 23: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION:	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL VISIBILITY CATEGORY (ST. MILES)								
				J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	All Categories
NO TREND			U	31	49	52	50	43	38	13	--	8
			S	69	27	28	28	39	46	79	95	85
			D	--	24	20	22	18	16	8	5	7
	INITIAL CASES			3230	1288	1629	1474	4278	7900	40481	114307	174587
1-HR UP TREND			U	--	61	55	57	55	45	18	--	18
			S	--	19	24	22	30	37	69	91	69
			D	--	20	21	21	15	18	13	9	13
	INITIAL CASES			--	289	396	372	850	1427	3969	5977	13280
1-HR STEADY TREND			U	27	42	49	41	36	33	12	--	4
			S	73	37	35	41	48	54	81	95	90
			D	--	21	16	18	16	13	7	5	6
	INITIAL CASES			2222	350	455	407	1670	3651	31879	108330	148964
1-HR DOWN TREND			U	40	47	52	53	44	40	18	--	34
			S	60	26	26	23	34	41	70	--	50
			D	--	27	22	24	22	19	12	--	16
	INITIAL CASES			1008	649	778	695	1758	2822	4633	--	12343
2-HR UP TREND			U	--	--	61	72	56	54	23	--	24
			S	--	--	24	14	31	32	65	92	65
			D	--	--	15	14	13	14	12	8	11
	INITIAL CASES			--	--	54	63	184	335	911	879	2426
2-HR STEADY TREND			U	27	32	47	35	29	28	10	--	3
			S	73	51	43	51	56	60	83	95	92
			D	--	17	10	14	15	12	7	5	5
	INITIAL CASES			1618	130	158	166	806	1974	25898	102918	133668
2-HR DOWN TREND			U	34	44	54	52	41	40	--	--	42
			S	66	28	26	26	34	37	--	--	40
			D	--	28	20	22	22	23	--	--	18
	INITIAL CASES			461	265	276	248	409	311	--	--	1970

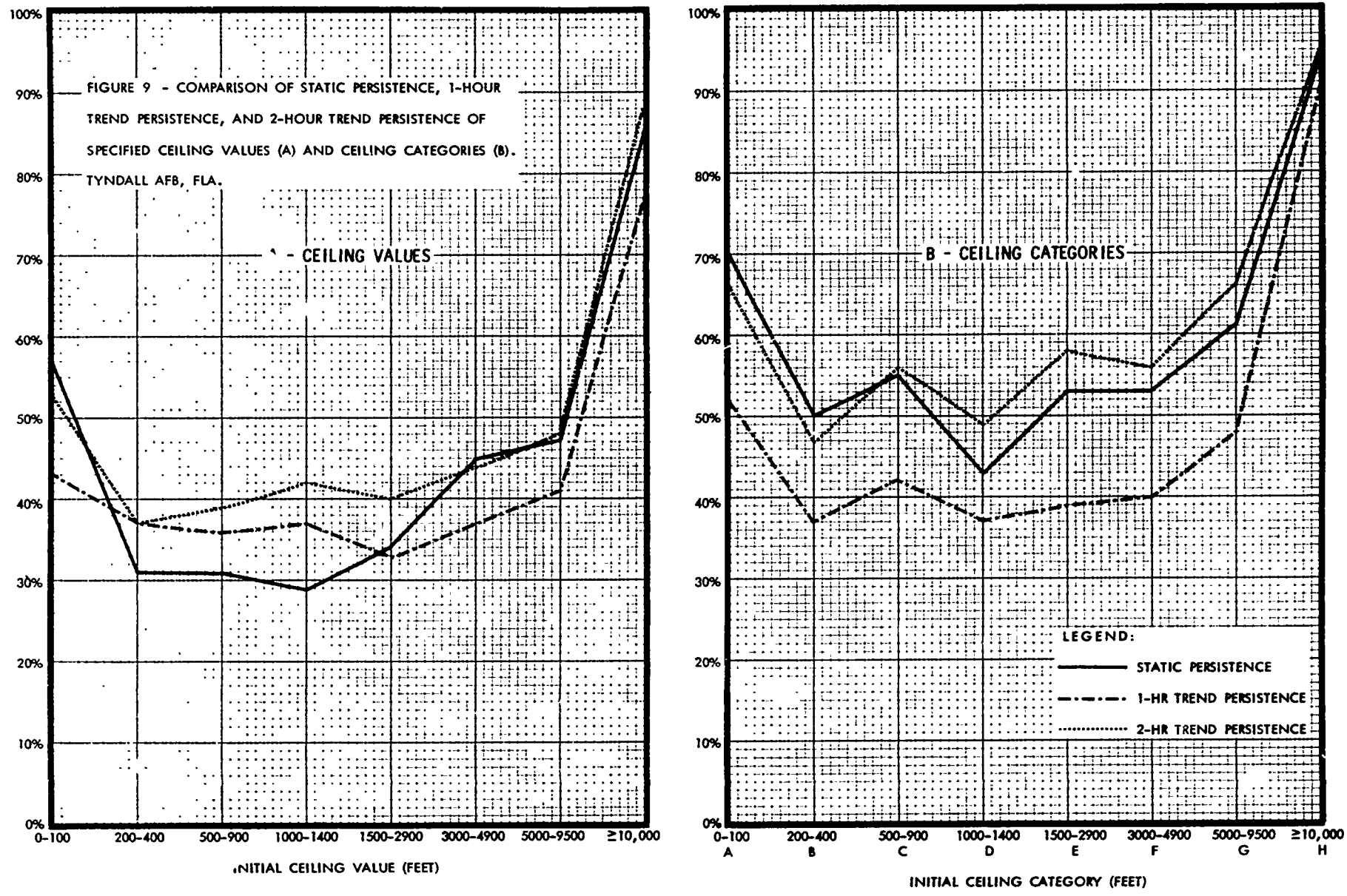


FIGURE 9 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED CEILING VALUES (A) AND CEILING CATEGORIES (B). TYNDALL AFB, FLA.

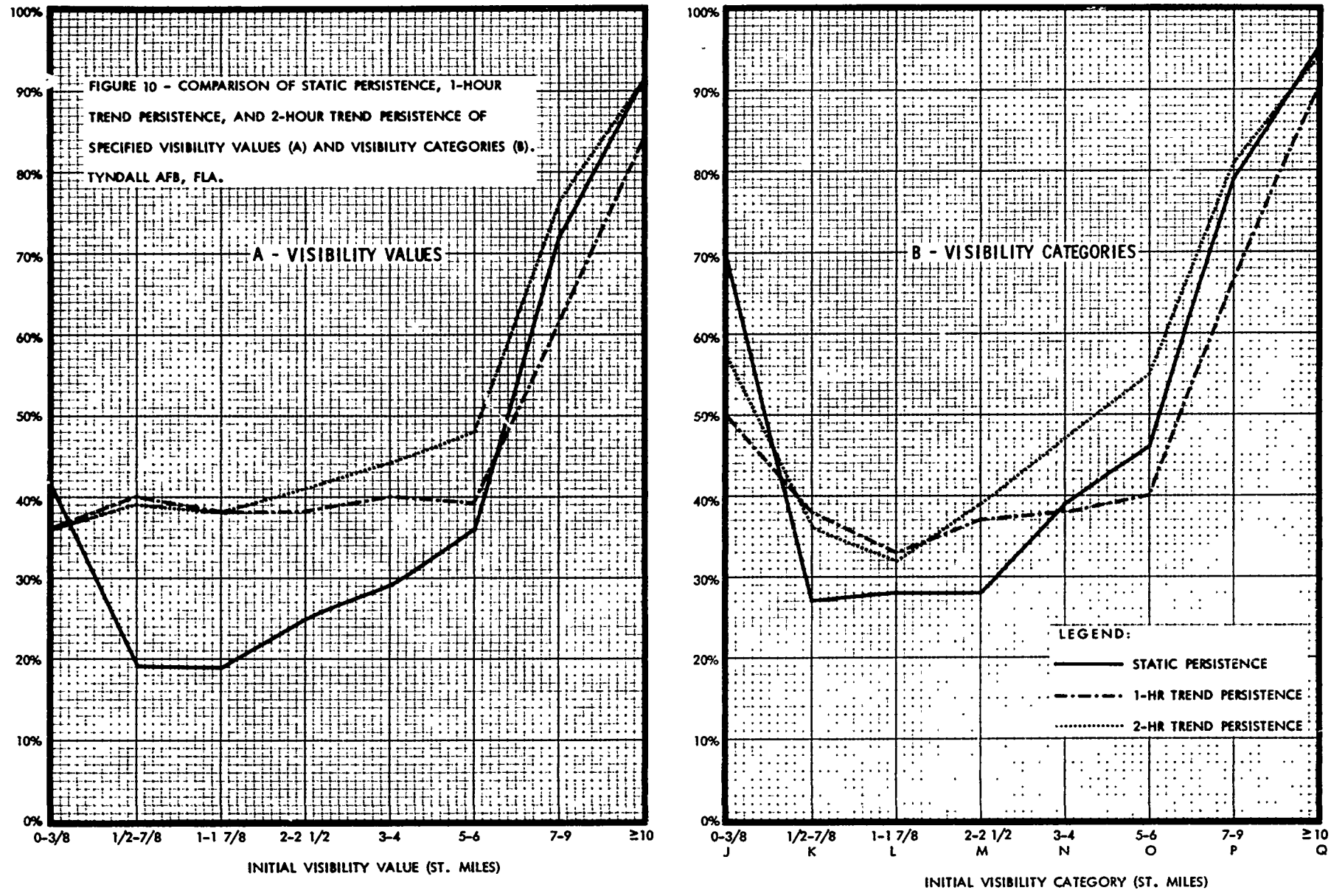


FIGURE 10 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED VISIBILITY VALUES (A) AND VISIBILITY CATEGORIES (B). TYNDALL AFB, FLA.

APPENDIX E

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

DULUTH IAP, MINNESOTA

TABLE 24: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

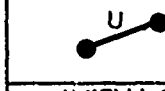
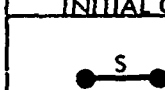
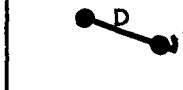
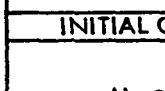
STATION: DLH	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET)								
				0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥10000	All Ceilings
NO TREND			U	31	41	46	47	48	46	39	5	21
			S	62	33	22	18	15	17	24	80	57
			D	7	26	32	35	37	37	37	15	22
	INITIAL CASES			4593	6344	8666	7125	11389	10033	10070	81794	140014
1-HR UP TREND			U	37	47	51	52	52	48	40	10	35
			S	48	30	20	17	13	14	21	60	33
			D	15	23	29	31	35	38	39	30	32
	INITIAL CASES			270	1622	2887	2694	4608	3792	3155	10764	29792
1-HR STEADY TREND			U	28	38	44	45	45	42	38	2	9
			S	67	38	28	24	22	26	30	87	78
			D	5	24	28	31	33	32	32	11	13
	INITIAL CASES			2828	2062	1897	1287	1668	1668	2369	65562	79341
1-HR DOWN TREND			U	38	40	44	43	46	46	40	28	40
			S	53	30	20	17	14	15	22	39	24
			D	9	30	36	40	40	39	38	33	36
	INITIAL CASES			1495	2660	3882	3144	5113	4573	4546	5468	30881
2-HR UP TREND			U	--	53	53	58	55	50	41	10	38
			S	--	26	20	17	12	15	21	62	31
			D	--	21	27	25	33	35	38	28	31
	INITIAL CASES			--	304	932	1044	2026	1559	1039	3436	10340
2-HR STEADY TREND			U	24	36	39	46	37	38	35	1	4
			S	72	44	30	30	28	36	34	90	86
			D	4	20	31	24	35	26	31	9	10
	INITIAL CASES			1904	785	531	305	373	436	706	57009	62049
2-HR DOWN TREND			U	36	38	40	40	42	42	37	27	39
			S	9	30	19	16	14	13	21	29	21
			D	55	32	41	44	44	45	42	44	40
	INITIAL CASES			637	1218	1745	1346	2007	1668	1490	858	10969

TABLE 25: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

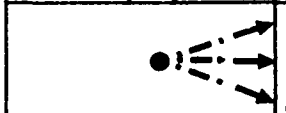
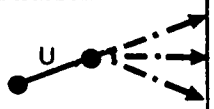
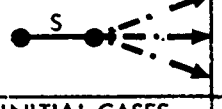
STATION: DLH	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL VISIBILITY VALUE (ST. MILES)								
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10	All Visibilities
NO TREND		U	39	49	47	42	45	48	45	4	11
		S	47	26	26	28	26	21	26	90	79
		D	14	24	27	30	29	31	29	6	10
	INITIAL CASES		4218	2270	3579	2997	4657	3427	4781	114081	140010
1-HR UP TREND		U	50	54	53	45	51	55	56	21	37
		S	31	21	21	38	24	17	20	61	42
		D	19	25	26	25	25	28	24	18	21
	INITIAL CASES		503	586	991	913	1528	1366	1828	7907	15622
1-HR STEADY TREND		U	33	44	42	38	38	39	35	1	4
		S	57	36	38	37	37	33	39	94	91
		D	10	20	20	25	25	28	26	5	5
	INITIAL CASES		1978	579	936	846	1216	713	1232	103058	110558
1-HR DOWN TREND		U	42	50	46	43	45	46	41	37	43
		S	40	22	22	23	21	18	23	32	26
		D	18	28	32	34	34	36	36	31	31
	INITIAL CASES		1737	1105	1652	1238	1913	1348	1721	3116	13830
2-HR UP TREND		U	53	49	53	48	57	57	58	23	37
		S	22	21	21	23	23	18	19	61	44
		D	25	30	26	29	20	25	23	16	19
	INITIAL CASES		40	122	232	272	514	478	731	3356	5745
2-HR STEADY TREND		U	30	36	36	33	34	30	30	1	2
		S	63	43	44	45	45	43	47	95	94
		D	7	21	20	22	21	27	23	4	4
	INITIAL CASES		1128	208	359	315	455	239	475	97238	100417
2-HR DOWN TREND		U	45	49	46	44	43	42	41	35	44
		S	36	23	23	23	23	20	24	33	26
		D	19	20	31	33	34	38	35	31	30
	INITIAL CASES		881	534	714	502	674	405	409	199	4318

TABLE 26: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and theprevious hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: DLH	PREVIOUS TRENDS / INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET) A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000	All Categories
NO TREND		U	26	28	27	30	24	28	24	--	11
		S	74	60	59	51	61	52	58	92	78
		D	--	12	14	19	15	20	18	8	11
	INITIAL CASES		4593	6344	8666	7125	11389	10033	10070	81794	140014
1-HR UP TREND	U	U	--	27	25	30	20	23	20	--	14
		S	--	57	56	48	57	44	49	76	61
		D	--	16	19	22	23	33	31	24	25
	INITIAL CASES		--	782	1231	1487	1891	1975	1474	6499	15339
1-HR STEADY TREND	S	U	22	25	25	28	22	25	22	--	8
		S	78	63	63	56	65	59	62	93	84
		D	--	12	12	16	13	16	16	7	8
	INITIAL CASES		3413	3789	5136	3650	6890	5228	6072	75295	109473
1-HR DOWN TREND	D	U	37	34	34	33	33	35	31	--	33
		S	63	54	52	46	51	47	55	--	52
		D	--	12	14	21	16	18	14	--	15
	INITIAL CASES		1180	1773	2299	1988	2608	2830	2524	--	15202
2-HR UP TREND	U U U	U	--	--	31	37	24	21	20	--	14
		S	--	--	50	45	55	40	46	73	59
		D	--	--	19	18	21	39	34	27	27
	INITIAL CASES		--	--	113	172	322	211	299	966	2083
2-HR STEADY TREND	S S	U	19	24	22	26	20	23	20	--	5
		S	81	66	67	61	68	63	64	94	88
		D	--	10	11	13	12	14	16	6	7
	INITIAL CASES		2662	2392	3257	2033	4494	2565	4198	70295	91896
2-HR DOWN TREND	D D	U	35	32	30	34	27	38	--	--	32
		S	65	58	51	40	51	40	--	--	51
		D	--	10	19	26	22	22	--	--	17
	INITIAL CASES		289	420	544	345	385	262	--	--	2245

TABLE 27: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down) this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: DLH	PREVIOUS TRENDS / INITIAL	FUTURE 1-HR CHANGES	INITIAL VISIBILITY CATEGORY (ST. MILES) J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	All Categories
NO TREND		U	28	43	41	45	41	48	40	--	7
		S	72	38	40	31	36	26	36	96	86
		D	--	19	19	24	23	26	24	4	7
	INITIAL CASES		4218	2270	3579	2997	4657	3427	4781	114081	140010
1-HR UP TREND	U	U	--	48	46	41	45	49	49	--	26
		S	--	32	34	32	34	25	30	86	55
		D	--	20	20	27	21	26	21	14	19
	INITIAL CASES		--	428	693	674	1278	1060	1550	6954	12637
1-HR STEADY TREND	S	U	23	35	35	35	35	36	33	--	2
		S	77	50	49	44	43	39	45	96	93
		D	--	15	16	21	22	25	22	4	5
	INITIAL CASES		2819	845	1398	896	1606	898	1628	107127	117217
1-HR DOWN TREND	D	U	38	47	43	53	43	53	39	--	45
		S	62	32	35	23	31	20	31	--	33
		D	--	21	22	24	26	27	30	--	22
	INITIAL CASES		1399	997	1488	1427	1773	1469	1603	--	10156
2-HR UP TREND	U U	U	--	--	46	49	50	51	52	--	24
		S	--	--	39	28	33	28	28	87	59
		D	--	--	15	23	17	21	20	13	17
	INITIAL CASES		--	--	52	115	243	245	405	1147	2207
2-HR STEADY TREND	S S	U	21	32	30	32	34	31	29	--	1
		S	79	55	55	50	47	45	51	96	95
		D	--	13	15	18	19	24	20	4	4
	INITIAL CASES		1772	336	537	364	562	326	595	93656	98148
2-HR DOWN TREND	D D	U	42	46	45	42	42	41	--	--	43
		S	58	36	36	28	34	27	--	--	39
		D	--	18	19	30	24	32	--	--	18
	INITIAL CASES		414	323	399	291	302	151	--	--	1880

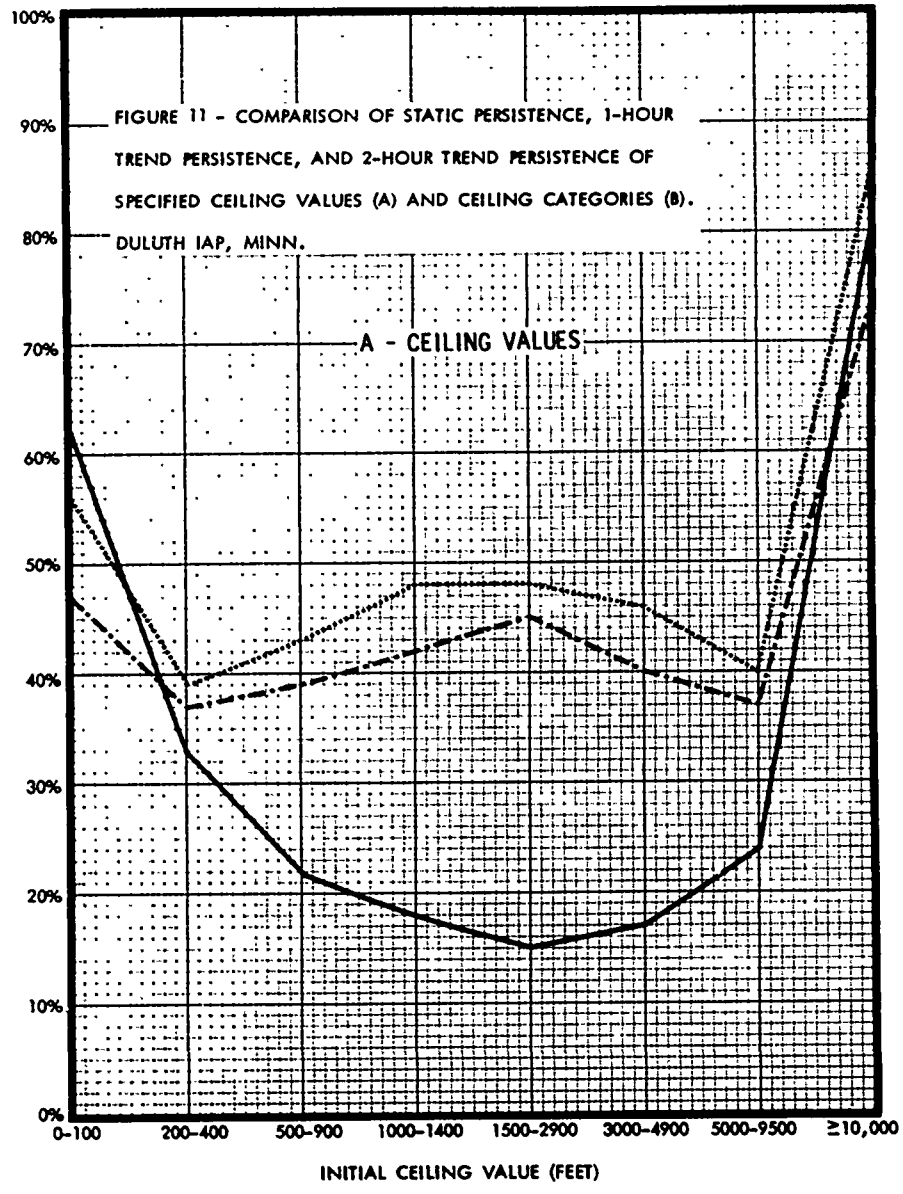
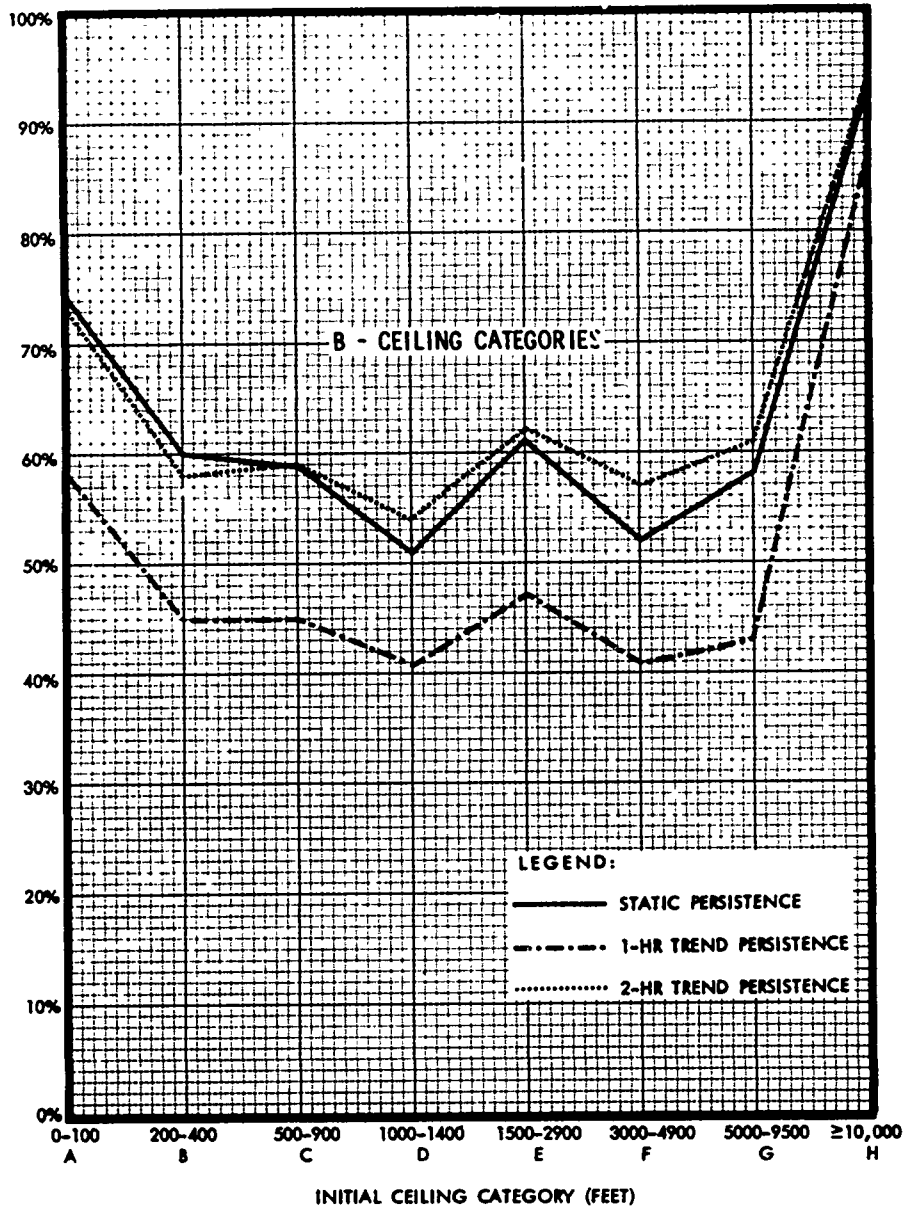


FIGURE 11 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED CEILING VALUES (A) AND CEILING CATEGORIES (B). DULUTH IAP, MINN.



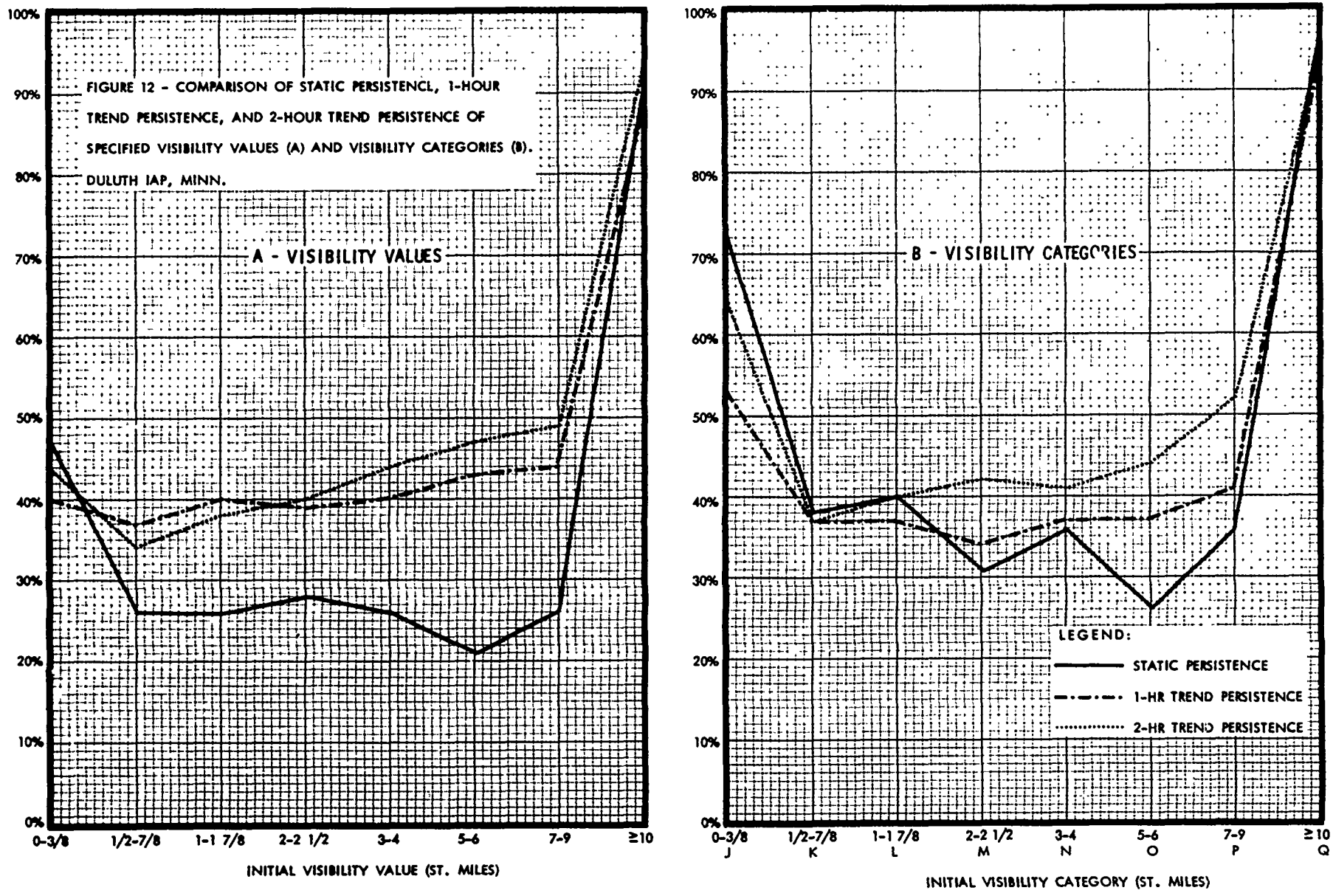


FIGURE 12 - COMPARISON OF STATIC PERSISTENCL, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED VISIBILITY VALUES (A) AND VISIBILITY CATEGORIES (B). DULUTH IAP, MINN.

APPENDIX F

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

HAMILTON AFB, CALIFORNIA

TABLE 28: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

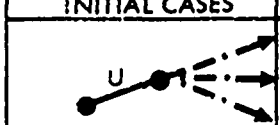
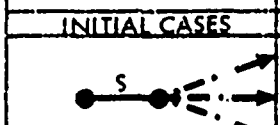
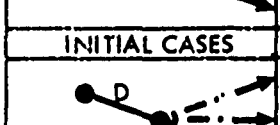
STATION: SRF	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL CEILING VALUE (FEET)								
			0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000	All Ceilings
NO TREND		U	31	44	42	44	42	33	25	2	12
		S	65	40	37	32	31	37	44	91	77
		D	4	16	21	24	27	30	31	7	11
	INITIAL CASES		2522	2814	8852	7081	12164	6140	4352	131223	175148
1-HR UP TREND		U	48	53	52	55	47	35	25	6	30
		S	38	34	29	24	27	33	41	74	47
		D	14	13	19	21	26	32	34	20	23
	INITIAL CASES		126	681	2266	2169	3911	1991	1116	7959	20219
1-HR STEADY TREND		U	29	39	38	39	38	30	25	2	6
		S	70	48	43	42	40	44	49	93	87
		D	1	13	19	19	22	26	26	5	7
	INITIAL CASES		1647	1135	3267	2297	3802	2241	1915	119437	135741
1-HR DOWN TREND		U	33	42	39	36	41	34	26	22	35
		S	60	36	36	31	28	33	40	57	38
		D	7	22	25	30	31	33	34	21	27
	INITIAL CASES		749	998	3319	2615	4451	1908	1321	3827	19188
2-HR UP TREND		U	--	57	59	64	54	34	29	6	34
		S	--	31	25	19	24	35	37	78	46
		D	--	12	16	17	22	31	34	16	20
	INITIAL CASES		--	129	611	659	1435	713	277	2306	6130
2-HR STEADY TREND		U	28	34	36	37	36	29	22	1	3
		S	71	55	46	49	46	47	54	95	92
		D	1	11	18	14	18	24	24	4	5
	INITIAL CASES		1147	545	1398	953	1516	1114	785	111361	118819
2-HR DOWN TREND		U	38	42	40	41	37	28	24	18	36
		S	57	38	36	28	27	33	42	50	35
		D	5	20	24	31	36	39	34	32	29
	INITIAL CASES		220	355	1142	843	1373	498	245	461	5137

TABLE 29: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

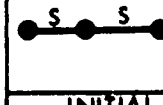
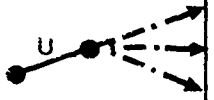
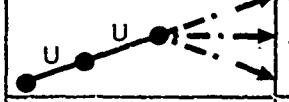
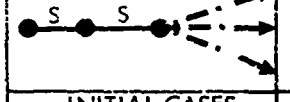
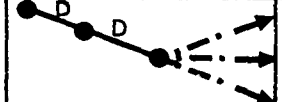
STATION: SRF	PREVIOUS TRENDS (INITIAL)	FUTURE 1-HR CHANGES	INITIAL VISIBILITY VALUE (ST. MILES) 0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10	All Visibilities
NO TREND		U	42	53	45	37	32	29	23	10	15
		S	45	22	34	39	49	50	63	77	70
		D	13	25	21	24	19	21	14	13	15
	INITIAL CASES		3427	1339	3394	3205	8160	7628	20946	127053	175152
1-HR UP TREND		U	55	65	56	52	45	46	32	18	27
		S	25	17	24	30	40	38	54	68	58
		D	20	18	20	18	15	16	14	14	15
	INITIAL CASES		490	427	906	907	1871	1686	3500	17108	26895
1-HR STEADY TREND		U	36	49	38	28	25	22	20	8	11
		S	57	29	45	52	57	60	69	80	76
		D	7	22	17	20	18	18	11	12	13
	INITIAL CASES		1545	294	1160	1263	4017	3798	13255	97763	123095
1-HR DOWN TREND		U	44	47	42	35	32	29	23	12	22
		S	39	22	32	33	42	41	54	67	55
		D	17	31	26	32	26	30	23	21	23
	INITIAL CASES		1392	618	1328	1035	2272	2144	4191	12182	25162
2-HR UP TREND		U	66	69	60	55	51	51	36	22	33
		S	16	9	25	31	39	35	53	65	54
		D	18	22	15	14	10	14	11	13	13
	INITIAL CASES		55	105	291	320	630	587	1104	4230	7322
2-HR STEADY TREND		U	33	47	31	19	21	19	19	7	10
		S	63	36	54	62	61	64	71	81	78
		D	4	17	15	19	18	17	10	12	12
	INITIAL CASES		876	86	515	650	2297	2281	9072	77868	93645
2-HR DOWN TREND		U	44	46	43	37	33	29	24	10	28
		S	38	22	29	31	38	41	51	72	48
		D	18	32	28	32	29	30	25	18	24
	INITIAL CASES		709	304	526	391	727	652	972	1556	5837

TABLE 30: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

STATION: SRF	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING CATEGORY (FEET) A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000	All Categories
NO TREND			U	26	31	24	28	22	21	18	--	6
			S	74	62	71	60	68	61	62	96	89
			D	--	7	5	12	10	18	20	4	5
	INITIAL CASES			2522	2814	8852	7081	12164	6140	4352	131223	175148
1-HR UP TREND	U		U	--	36	27	36	22	20	18	--	13
			S	--	54	62	50	62	54	54	83	69
			D	--	10	11	14	16	26	28	17	18
	INITIAL CASES			--	330	644	1045	1494	1215	787	4880	10395
1-HR STEADY TREND	S		U	24	28	22	26	20	20	17	--	4
			S	76	67	73	64	71	64	65	97	92
			D	--	5	5	10	9	16	18	3	4
	INITIAL CASES			1869	1732	6273	4289	8232	3726	2699	126343	155163
1-HR DOWN TREND	D		U	30	35	27	27	30	23	23	--	28
			S	70	52	67	58	60	59	59	--	61
			D	--	13	6	15	10	18	18	--	11
	INITIAL CASES			653	752	1935	1747	2438	1199	866	--	9590
2-HR UP TREND	U U		U	--	--	32	48	29	24	15	--	10
			S	--	--	64	29	52	52	52	89	75
			D	--	--	4	23	19	24	33	11	15
	INITIAL CASES			--	--	66	52	161	89	128	889	1'85
2-HR STEADY TREND	S S		U	24	27	22	26	18	19	15	--	3
			S	76	69	74	67	73	66	68	97	93
			D	--	4	4	7	9	15	17	3	4
	INITIAL CASES			1412	1164	4574	2749	5836	2372	1763	122306	142176
2-HR DOWN TREND	D D		U	38	36	24	29	30	12	--	--	28
			S	62	55	74	57	60	67	--	--	64
			D	--	9	2	14	10	21	--	--	8
	INITIAL CASES			125	121	313	190	262	69	--	--	1080

TABLE 31: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: SRF	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL VISIBILITY CATEGORY (ST. MILES)								
			J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	All Categories
NO TREND		U	28	47	36	31	25	25	18	--	7
		S	72	32	50	50	61	58	72	96	87
		D	--	21	14	19	14	17	10	4	6
	INITIAL CASES		3427	1339	3394	3205	8160	7628	20946	127053	175152
1-HR UP TREND		U	--	60	46	45	36	40	23	--	21
		S	--	23	36	38	50	45	66	89	66
		D	--	17	18	17	14	15	11	11	13
	INITIAL CASES		--	345	606	717	1347	1323	2504	4637	11479
1-HR STEADY TREND		U	24	43	32	25	21	20	16	--	4
		S	76	40	57	59	67	66	75	97	91
		D	--	17	11	16	12	14	9	3	5
	INITIAL CASES		2472	428	1683	1596	4935	4465	15077	122416	153072
1-HR DOWN TREND		U	38	43	37	32	29	26	21	--	29
		S	62	31	42	42	51	50	63	--	53
		D	--	26	21	26	20	24	16	--	18
	INITIAL CASES		955	566	1105	892	1878	1840	3365	--	10601
2-HR UP TREND		U	--	--	47	51	41	45	24	--	23
		S	--	--	42	35	51	43	66	87	65
		D	--	--	11	14	8	12	10	13	12
	INITIAL CASES		--	--	98	134	367	312	667	818	2396
2-HR STEADY TREND		U	23	40	29	17	18	18	16	--	3
		S	77	47	61	68	70	68	76	97	93
		D	--	13	10	15	12	14	8	3	4
	INITIAL CASES		1878	174	969	944	3303	2953	11304	118281	139806
2-HR DOWN TREND		U	38	42	37	36	28	23	--	--	34
		S	62	31	42	38	51	56	--	--	48
		D	--	27	21	26	21	21	--	--	18
	INITIAL CASES		414	222	338	247	415	293	--	--	1929

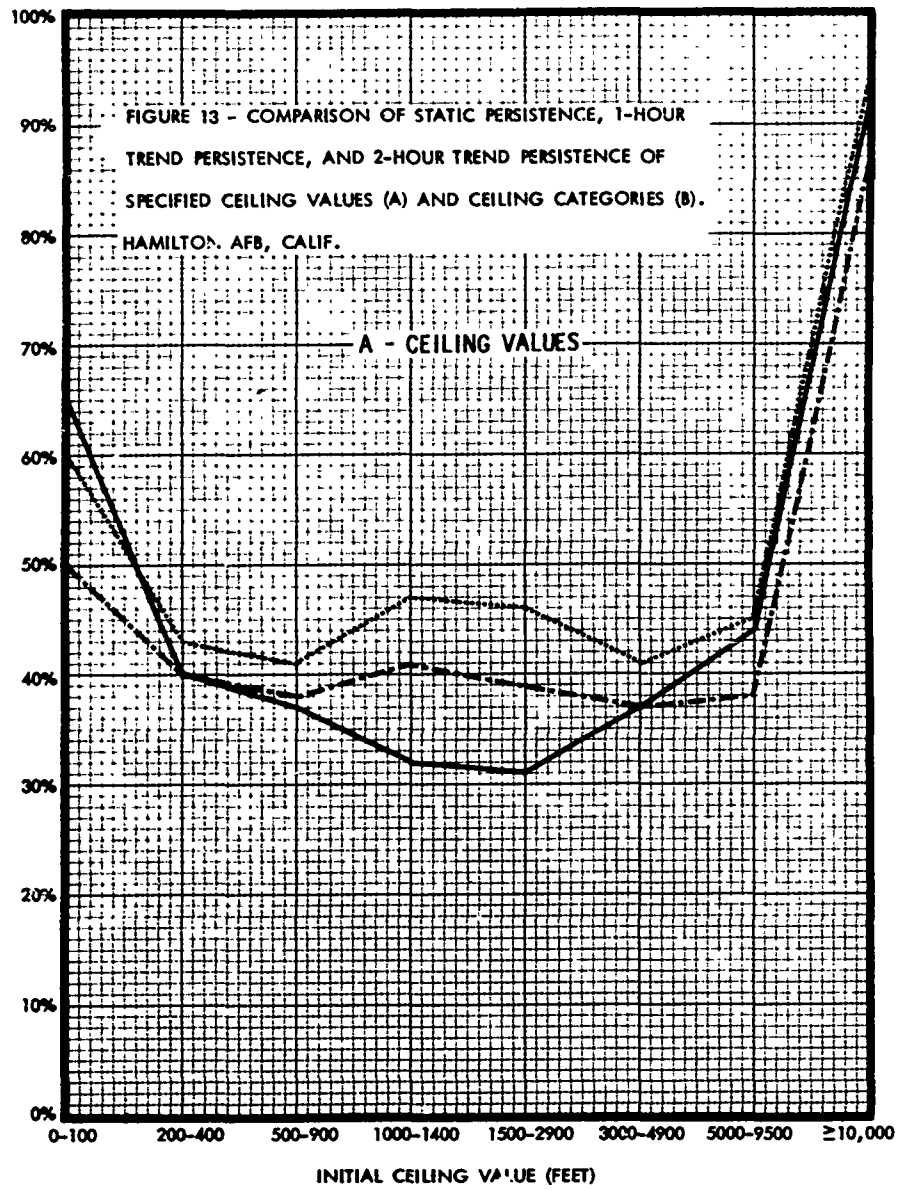
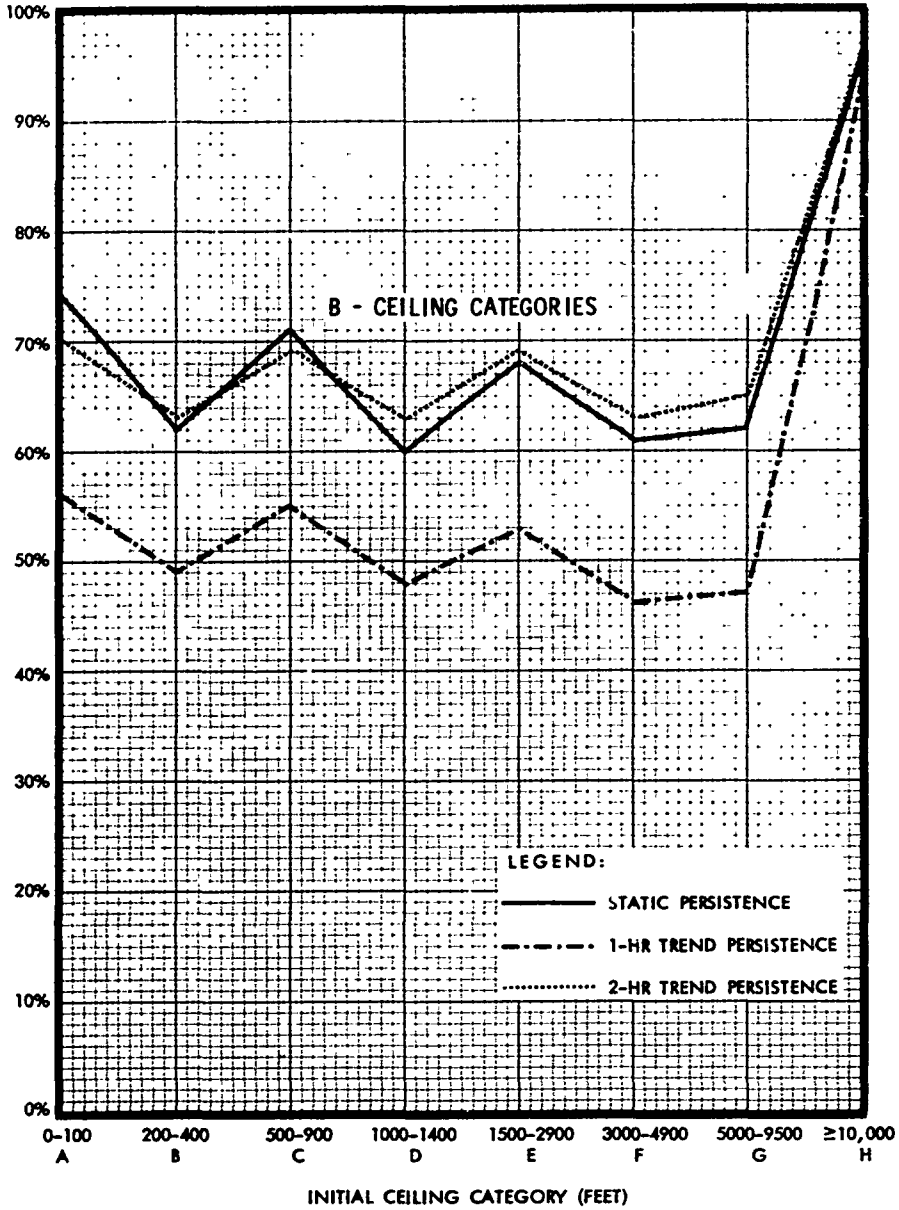


FIGURE 13 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED CEILING VALUES (A) AND CEILING CATEGORIES (B). HAMILTON AFB, CALIF.



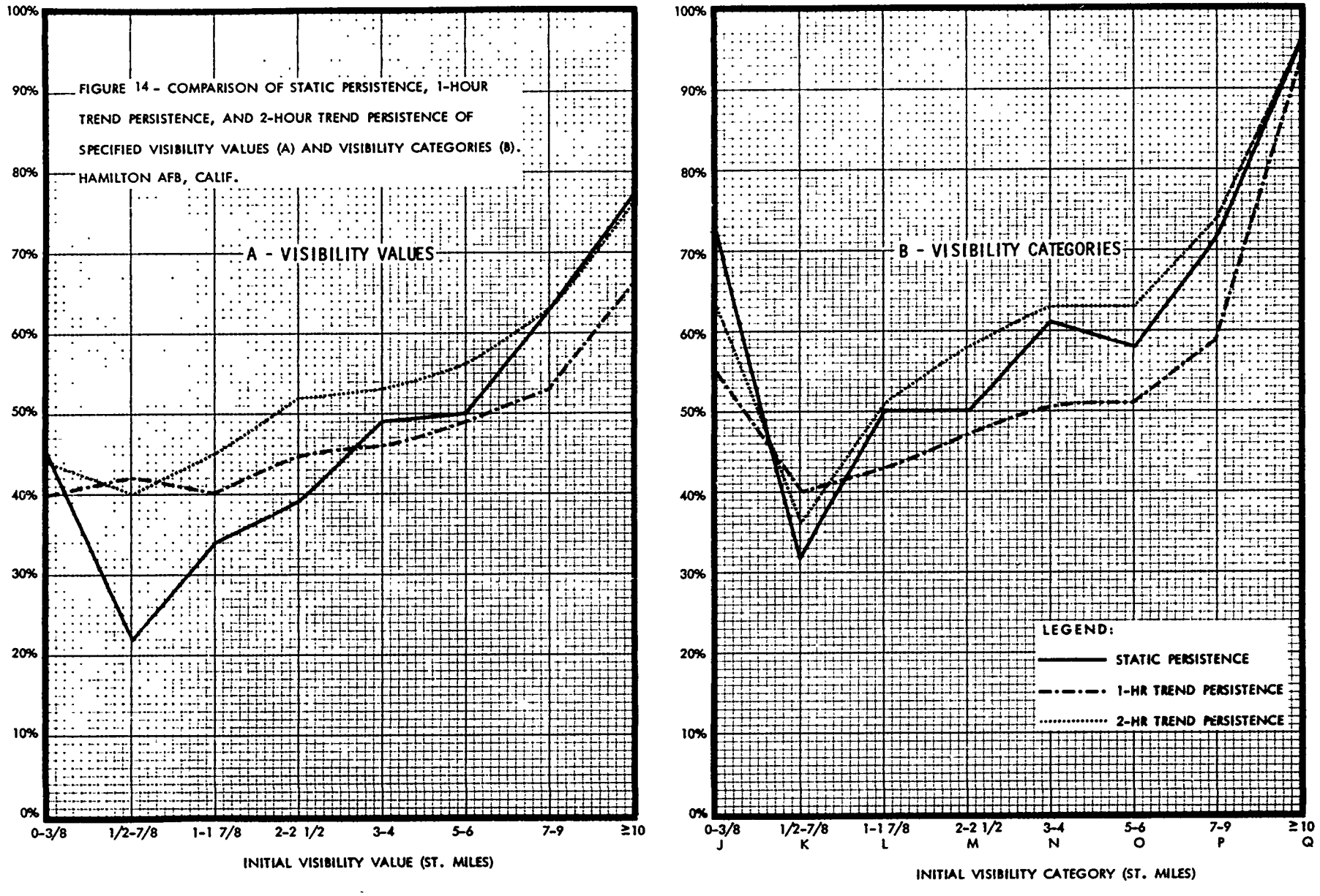


FIGURE 14 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED VISIBILITY VALUES (A) AND VISIBILITY CATEGORIES (B). HAMILTON AFB, CALIF.

APPENDIX G

ANALYSIS OF STATIC AND TREND PERSISTENCE

FOR

RICHARDS-GEBAUR AFB, MISSOURI

TABLE 32: Percentage frequency of one-hour changes in ceiling values from an initial ceiling value. Given an initial ceiling value and the previous hourly ceiling trends (U-up, S-same, D-down), this table shows the percentage of time that the ceiling value one hour later is higher, the same, or lower than the initial value.

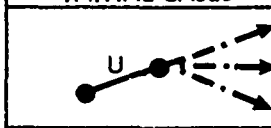
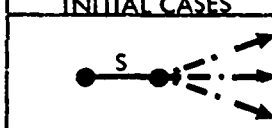
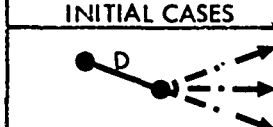
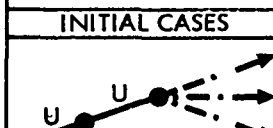
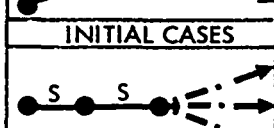
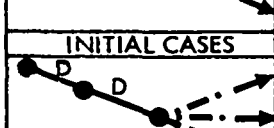
STATION: GVW	PREVIOUS TRENDS	INITIAL	FUTURE 1-HR CHANGES	INITIAL CEILING VALUE (FEET) 0-100	200-400	500-900	1000-1400	1500-2900	3000-4900	5000-9500	≥ 10000	All Ceilings
NO TREND			U	33	39	41	44	43	37	26	4	14
			S	62	44	34	30	32	39	51	86	72
			D	5	17	25	26	25	24	23	10	14
	INITIAL CASES			968	2457	4005	2815	6134	4946	8461	68810	98596
1-HR UP TREND			U	34	49	48	50	48	38	35	9	28
			S	60	36	32	27	29	35	41	70	50
			D	6	15	20	23	23	27	24	21	22
	INITIAL CASES			62	499	1168	942	1968	1352	1550	6228	13769
1-HR STEADY TREND			U	32	35	37	39	42	35	25	2	8
			S	64	50	39	38	39	45	54	90	82
			D	4	15	24	23	19	20	21	8	10
	INITIAL CASES			602	1092	1356	844	1918	1851	4218	59109	70990
1-HR DOWN TREND			U	34	38	39	42	41	36	24	22	32
			S	59	43	30	26	27	37	50	53	41
			D	7	19	31	32	32	27	26	25	27
	INITIAL CASES			304	866	1481	1029	2248	1743	2693	3473	13837
2-HR UP TREND			U	--	48	52	56	51	43	36	9	33
			S	--	41	31	25	29	31	40	68	45
			D	--	11	17	19	20	26	24	23	22
	INITIAL CASES			--	91	370	348	766	477	357	1475	3884
2-HR STEADY TREND			U	30	31	29	31	39	33	23	2	4
			S	66	54	47	47	42	49	56	91	88
			D	4	15	24	22	18	18	21	7	8
	INITIAL CASES			384	542	535	320	743	1101	1966	52927	58518
2-HR DOWN TREND			U	31	40	37	41	38	36	21	20	34
			S	63	38	29	25	23	35	48	48	35
			D	6	22	34	34	39	29	31	32	31
	INITIAL CASES			117	371	588	380	762	662	535	327	3742

TABLE 33: Percentage frequency of one-hour changes in visibility values from an initial visibility value. Given an initial visibility value and the previous hourly visibility trends (U-up, S-same, D-down), this table shows the percentage of time that the visibility value one hour later is higher, the same, or lower than the initial value.

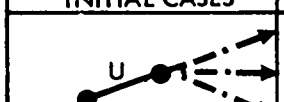
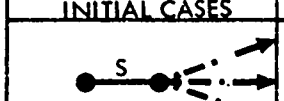
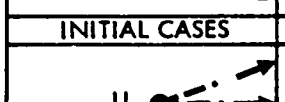
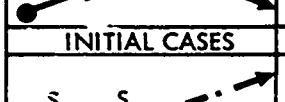
STATION: GVW	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL VISIBILITY VALUE (ST. MILES)								
			0-3/8	1/2-7/8	1-1 7/8	2-2 1/2	3-4	5-6	7-9	≥ 10	All Visibilities
NO TREND		U	44	45	49	43	35	38	30	3	10
		S	41	31	27	31	43	37	51	91	81
		D	15	24	24	26	22	25	19	6	9
	INITIAL CASES		1150	988	1932	1626	3446	3290	6748	79416	98596
1-HR UP TREND		U	49	53	57	52	46	53	42	14	31
		S	33	26	20	24	36	31	44	76	55
		D	18	21	23	24	18	16	14	10	14
	INITIAL CASES		182	223	589	496	940	875	1501	4993	9799
1-HR STEADY TREND		U	40	35	40	35	28	32	26	2	5
		S	48	42	39	42	52	49	59	93	89
		D	12	23	21	23	20	19	15	5	6
	INITIAL CASES		468	307	520	499	1457	1205	3458	72075	79989
1-HR DOWN TREND		U	47	47	24	44	37	34	28	22	33
		S	36	27	48	27	34	29	42	25	38
		D	17	26	28	29	29	37	30	53	29
	INITIAL CASES		500	458	823	631	1049	1210	1789	2348	8808
2-HR UP TREND		U	44	59	56	50	48	55	46	16	34
		S	24	13	20	27	34	30	43	74	53
		D	32	28	24	23	18	15	11	10	13
	INITIAL CASES		25	39	169	164	340	331	499	1445	3012
2-HR STEADY TREND		U	38	35	37	32	23	26	24	1	3
		S	54	47	46	44	58	56	62	94	92
		D	8	18	17	24	19	18	14	5	5
	INITIAL CASES		225	129	203	209	764	586	2037	67042	71195
2-HR DOWN TREND		U	50	51	46	47	35	34	27	20	38
		S	36	26	23	24	33	26	42	52	32
		D	14	23	31	29	32	40	31	28	30
	INITIAL CASES		272	211	338	245	477	408	384	157	2492

TABLE 34: Percentage frequency of one-hour changes in ceiling categories from an initial ceiling category. Given an initial ceiling category and the previous hourly trends in ceiling categories (U-up, S-same, D-down), this table shows the percentage of time that the ceiling category one hour later is higher, the same, or lower than the initial category.

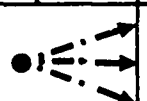
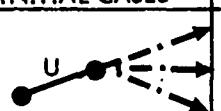
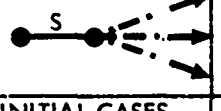
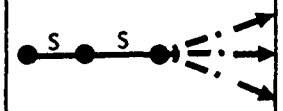
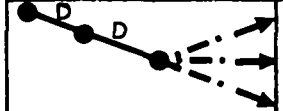
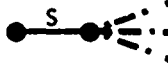
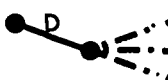
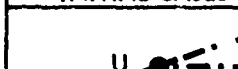
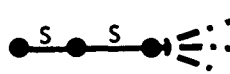
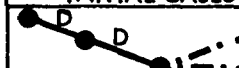
STATION: GVW	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL CEILING CATEGORY (FEET)								
			A 0-100	B 200-400	C 500-900	D 1000-1400	E 1500-2900	F 3000-4900	G 5000-9500	H ≥ 10000	All Categories
NO TREND		U	26	27	23	31	24	26	19	--	7
		S	74	66	66	54	65	58	68	95	86
		D	--	7	11	15	11	16	13	5	7
	INITIAL CASES		968	2457	4005	2815	6134	4947	8461	68809	98596
1-HR UP TREND		U	--	27	19	31	21	24	21	--	12
		S	--	64	67	52	62	51	56	82	69
		D	--	9	14	17	17	25	23	18	19
	INITIAL CASES		--	198	477	558	799	767	907	3433	7139
1-HR STEADY TREND		U	24	24	21	27	23	26	18	--	5
		S	76	69	69	59	67	61	71	96	89
		D	--	7	10	14	10	13	11	4	6
	INITIAL CASES		714	1633	2634	1528	3960	2866	5762	65376	84473
1-HR DOWN TREND		U	33	33	32	36	31	28	23	--	29
		S	67	61	55	46	58	57	65	--	59
		D	--	6	13	18	11	15	12	--	12
	INITIAL CASES		254	626	894	729	1375	1314	1792	--	6984
2-HR UP TREND		U	--	--	36	45	23	25	23	--	13
		S	--	--	56	44	66	39	55	82	69
		D	--	--	8	11	11	36	22	18	18
	INITIAL CASES		--	--	39	54	129	67	127	448	864
2-HR STEADY TREND		U	22	22	20	26	22	24	17	--	3
		S	78	72	71	60	69	64	72	96	92
		D	--	6	9	14	9	12	11	4	5
	INITIAL CASES		543	1123	1817	900	2667	1736	4097	62564	75447
2-HR DOWN TREND		U	33	33	33	42	29	33	--	--	33
		S	67	59	52	43	58	50	--	--	54
		D	--	8	15	15	13	17	--	--	13
	INITIAL CASES		55	150	207	114	199	131	--	--	856

TABLE 35: Percentage frequency of one-hour changes in visibility categories from an initial visibility category. Given an initial visibility category and the previous hourly trends in visibility categories (U-up, S-same, D-down), this table shows the percentage of time that the visibility category one hour later is higher, the same, or lower than the initial category.

STATION: GVW	PREVIOUS TRENDS / INITIAL / FUTURE 1-HR CHANGES		INITIAL VISIBILITY CATEGORY (ST. MILES)								
			J 0-3/8	K 1/2-7/8	L 1-1 7/8	M 2-2 1/2	N 3-4	O 5-6	P 7-9	Q ≥ 10	All Categories
NO TREND		U	29	37	36	38	28	33	24	--	6
		S	71	47	48	40	55	47	61	97	89
		D	--	16	16	22	17	20	15	3	5
	INITIAL CASES		1150	988	1932	1626	3446	3290	6748	79416	98596
1-HR UP TREND		U	--	45	42	45	34	44	33	--	23
		S	--	45	44	35	49	42	54	89	64
		D	--	10	14	20	17	14	13	11	13
	INITIAL CASES		--	148	348	408	684	705	1119	2300	5712
1-HR STEADY TREND		U	25	31	32	32	24	29	22	--	3
		S	75	52	54	48	61	53	66	97	93
		D	--	17	14	20	15	18	12	3	4
	INITIAL CASES		820	460	933	657	1895	1533	4138	77116	87552
1-HR DOWN TREND		U	38	42	40	40	33	32	25	--	33
		S	62	40	42	36	46	40	53	--	46
		D	--	18	18	24	21	28	22	--	21
	INITIAL CASES		330	380	651	561	867	1052	1491	--	5332
2-HR UP TREND		U	--	--	43	38	32	48	35	--	22
		S	--	--	40	40	52	40	54	89	65
		D	--	--	17	22	16	12	11	11	13
	INITIAL CASES		--	--	42	81	166	177	297	543	1306
2-HR STEADY TREND		U	23	28	31	26	19	23	20	--	2
		S	77	56	57	52	65	60	69	97	95
		D	--	16	12	22	16	17	11	3	3
	INITIAL CASES		617	240	507	313	1158	817	2744	75058	81454
2-HR DOWN TREND		U	44	44	35	46	26	31	--	--	36
		S	56	45	43	32	52	43	--	--	46
		D	--	11	22	22	22	26	--	--	18
	INITIAL CASES		154	135	209	155	291	188	--	--	1132

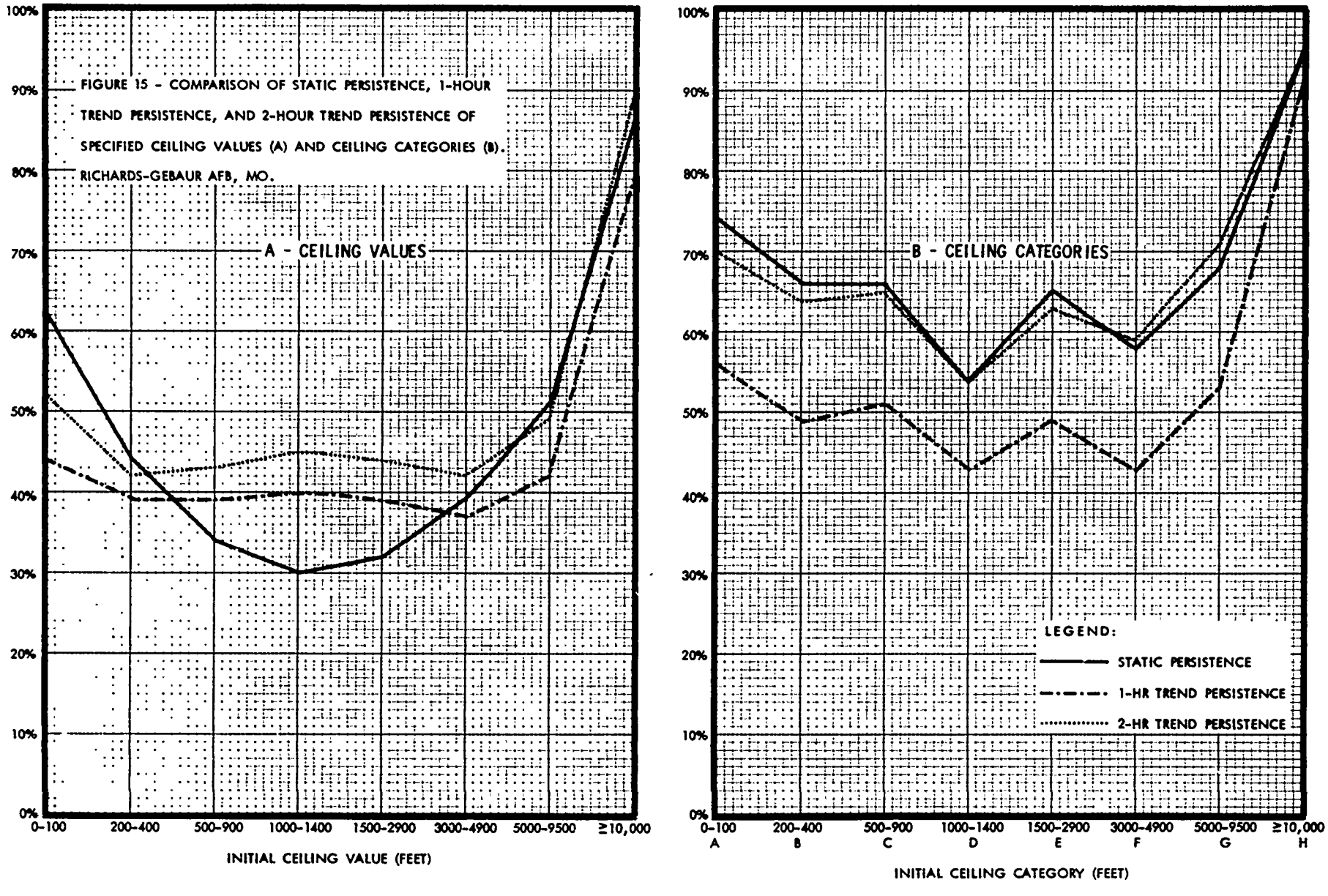


FIGURE 15 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED CEILING VALUES (A) AND CEILING CATEGORIES (B). RICHARDS-GEBAUR AFB, MO.

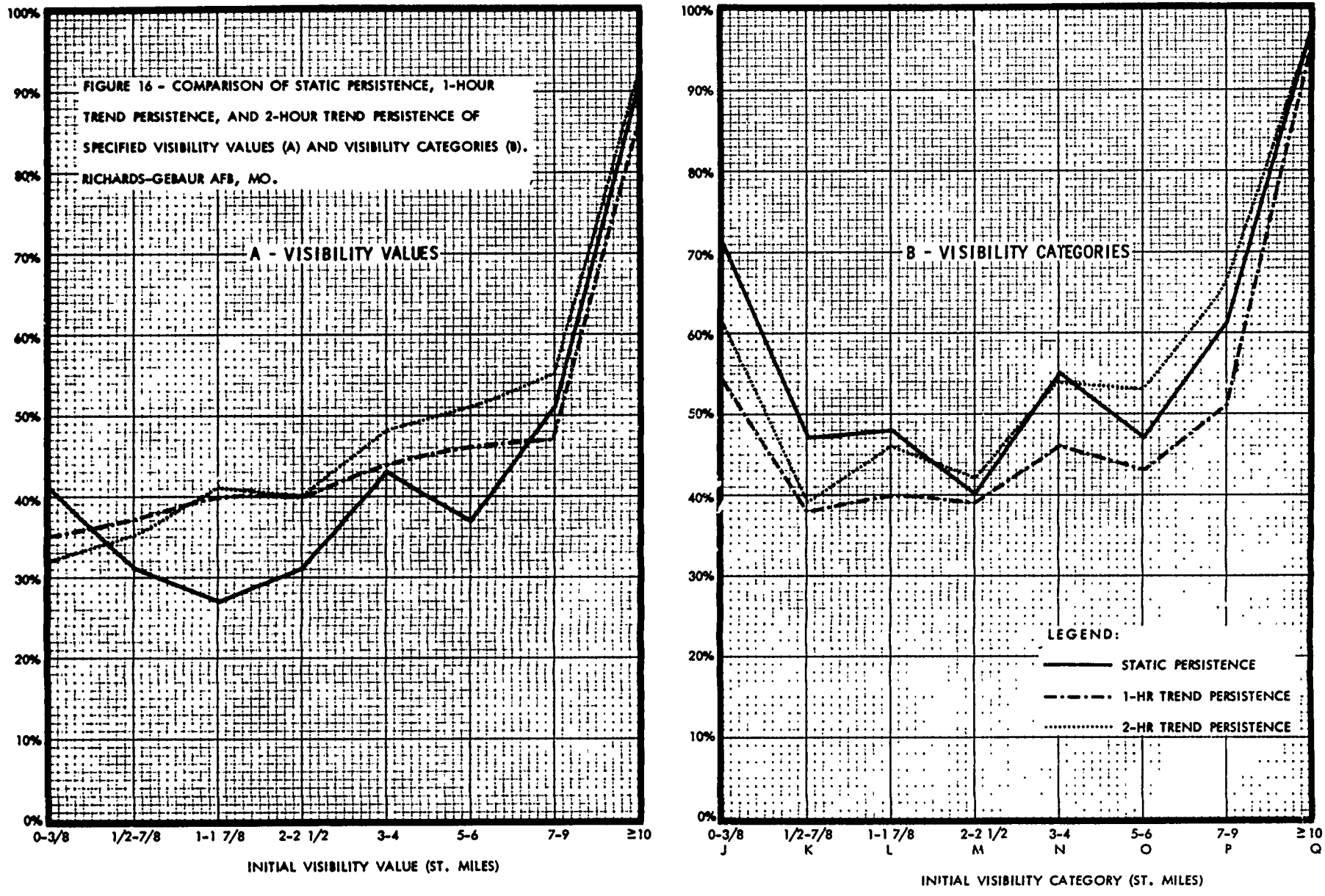


FIGURE 16 - COMPARISON OF STATIC PERSISTENCE, 1-HOUR TREND PERSISTENCE, AND 2-HOUR TREND PERSISTENCE OF SPECIFIED VISIBILITY VALUES (A) AND VISIBILITY CATEGORIES (B). RICHARDS-GEBAUR AFB, MO.

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13. ABSTRACT

This paper describes some of the various applications of persistence by different meteorological agencies; identifies certain areas of confusion; clarifies the definition of the general term "persistence;" and presents a full-scale statistical evaluation of static and trend persistence based upon the period of record at seven terminals. The results of this evaluation provide a reliable estimate of the value of static and trend persistence in the one-hour prediction of ceiling and visibility.

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